# Compressed Air Magazine

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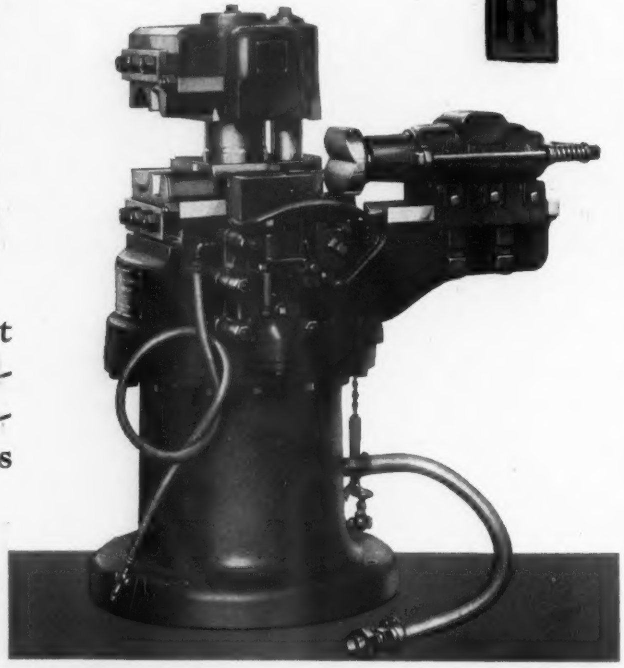
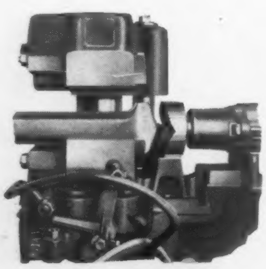
# Announcing The "WD" Well Drill Sharpener



The "WD" Sharpener has behind it Ingersoll-Rand's twenty years of experience in building drill steel sharpeners. In addition, it had two years of successful field operation actually sharpening well drill bits before it was offered to the trade.



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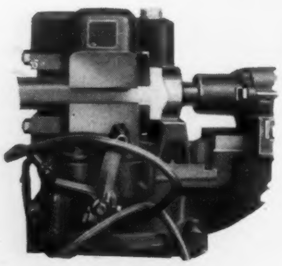

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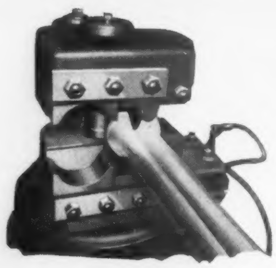

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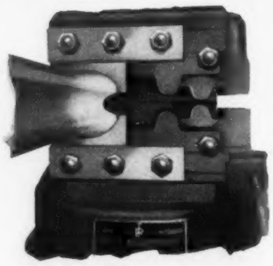

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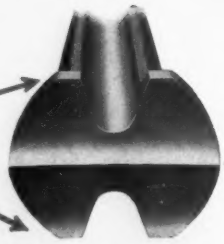



*One* quarry reports the "WD" Sharpener has cut their drilling costs 61 per cent. *Two* other quarries report cuts of 50 per cent in drilling costs. *All three* quarries report a saving of 50 per cent in sharpening costs.

*Our nearest branch will be glad to give you further information.*

**Ingersoll-Rand**
11 Broadway, New York City

# As It Seems To Us

### THE ST. LAWRENCE TREATY

A TREATY has been signed by the United States and Canada which envisions an expenditure far greater than the combined cost of the Hoover Dam and the Panama Canal. It clears the way for digging and blasting a deep-water channel from the Atlantic Ocean through the St. Lawrence River to the Great Lakes. It is estimated that ten years will be required to complete the undertaking. The total cost is set at $543,429,000, which will be divided about equally between the two signatories. Provision is made, however, that each country shall be given credit for expenditures already made for works which will become a part of the general scheme. Canada thus has written off $128,000,000 of her share by virtue of having placed the Welland Canal in service.

Formal signing of the treaty culminated negotiations of many years' standing. Twelve years ago a joint commission took the entire project in hand for detailed study and report, and eminent engineers have since considered it at length and made numerous recommendations as to the manner of carrying it out. In the end, the views of Canadian technicians prevailed in the main; and it has been decided to build two dams instead of one. This will increase the contemplated cost by some $34,000,000; but it will provide certain benefits in return. About two-thirds of the work is to be done in American territory and one-third in Canadian areas. Each country will utilize home labor and materials so far as this is possible; and it is expected that thousands of men will be given work.

In connection with the dams to be thrown across the St. Lawrence at Crysler and Barnhart islands, there will be installed hydroelectric machinery which will develop around 2,200,000 hp. of electrical energy. This will flow in equal proportions to the respective sides of the international boundary.

The effect of the waterway will be to permit 90 per cent of the ocean-going vessels of the world to enter the Great Lakes. It will lower transportation charges on basic commodities going into and out of an area in the two countries that is inhabited by 40,000,000 persons. This region yields vast quantities of industrial and agricultural products, and has a surplus which must be moved long distances for disposal. As an example of what may be expected, it is estimated that a saving of six cents a bushel will be made on moving wheat from the Great Lakes ports to Europe.

Now that the treaty has been signed, some of the American communities that will be affected by it are not sure that they want it. In its wake it will bring additional huge expenditures which will have to be met by the taxpayers in the several sections. The seaway will be 27 feet deep, which means that every port on the Great Lakes which expects to reap water traffic from the improvements will have to deepen its own harbor to accommodate the ships that will come up from the ocean. Chambers of commerce are now launching investigations to determine whether the benefits that may reasonably be hoped for will be commensurate with the cost. The completion of the channel may materially affect the standing of established seaboard ports. Much traffic that now flows through New York, Boston, and Baltimore may be diverted from them.

### STONE MOUNTAIN AGAIN

GUTZON BORGLUM, impetuous virtuoso of the sculptor's tools who exploded the theory that one must be born abroad to achieve the heights as an artist, may yet return to Stone Mountain, Georgia, to write *finis* on the massive memorial to the heroes of the Confederacy. Conferences between Mr. BORGLUM and those most concerned with the completion of the monument have been resumed, and have a good chance of reaching an amicable agreement.

Dismissed from his commission to perform the work, Mr. BORGLUM destroyed his models, fought two indictments brought against him for so doing, and was upheld by the courts. From Georgia he turned to South Dakota, and there began the carving of an even more colossal epic which will depict four presidents of the nation in the granite of Mt. Rushmore. This work will require several more years. Meanwhile, the Stone Mountain venture progressed slowly in the hands of another sculptor, and activity was finally suspended in 1928 because of a shortage of funds.

When overtures to resume the work were made to him, Mr. BORGLUM advanced new ideas and suggested enlarging the scale of the figures, as originally planned, to even more heroic proportions. In view of his success at Mt. Rushmore, it is likely that the sculptor will have his way, and it is also probable that the South will be pleased with what he will leave to posterity.

Born in Nevada and educated in the fundamentals of art in Omaha and San Francisco, Mr. BORGLUM topped off his training in Paris and speedily won acclaim as a sculptor in all parts of the world, after first having successfully tried painting as a medium of expression. His statues adorn the gathering places of large cities on both sides of the Atlantic; and he has designed commemorative coins for our Government. He introduced the use of rock drills and other compressed-air tools for large-scale carving.

### EXPLORING THE STRATOSPHERE

EVEN though men not yet grown gray can remember the first, faltering flights of the Wright Brothers at Kitty Hawk, aviation has taken strides whose magnitude belies its youth. The world is watching with interest the current efforts to develop planes which will glide through the upper air levels at speeds which a few years ago would have seemed incredible, to say the least. Yet, in view of what has already been accomplished, little surprise will greet the announcement that the latest objective has been reached.

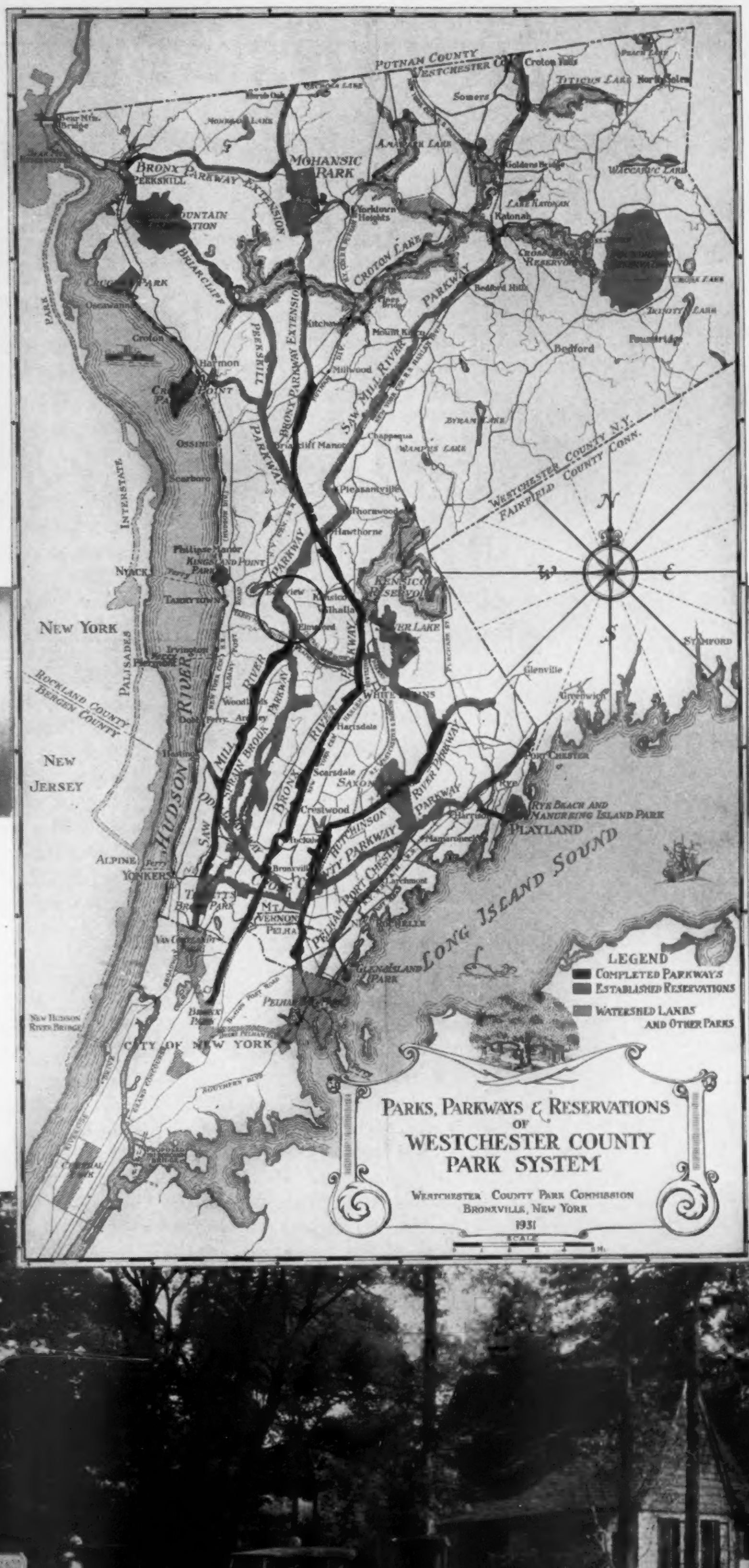
The rarer atmosphere does not have the same supporting power as that nearer the earth, nor does it provide the same thrust for the propellers of a plane. It does, however, resist the forward motion of a craft to a lesser degree. And, since aerodynamic engineers have found that the resistance may be made to lessen faster than the thrust as the air grows lighter, it would seem that planes constructed of light aluminum alloys and bearing multi-bladed propellers should be able to cleave the stratosphere at great speeds.

One such ship built in France for a try at rare-atmosphere flying has an airtight cabin. It is planned to seal this compartment at 9,000 feet and to lead into it outside air which will first be compressed to a density that will make breathing no more difficult than at sea level. Other compressors, the familiar superchargers, will supply the engines with vital oxygen. This is a thumb-nail sketch of the sort of plane that is expected to whisk hurrying humanity across the Atlantic in a matter of six hours.

### THE CONSTRUCTION BACKLOG

THE American Society of Civil Engineers, intent upon doing something to alleviate the unemployment that exists among technical men, has uncovered the amazing fact that the nation now holds in abeyance projected public works estimated to cost $2,250,000,000. Were they being carried on, 2,000,000 fewer people would be inactive today. Exclusive of Federal undertakings, state and municipal works normally call for expenditures of from $2,500,000,000 to $3,000,000,000 annually, but this year they will not reach $800,000,000.

Most of the postponed programs call for projects that are wholly or partially self-liquidating or that could be made so. These activities have been held up primarily because it has been difficult to market bonds and, secondarily, because of the clamor for lower taxes. The Society is interesting itself in an effort to find ways and means to release this immense backlog of construction, much of which consists of needed improvements.





On the map a circle marks the location of the work described in the accompanying article. The views at the top of the page are in Kingsland Point Park.

Farragut gasoline station in Saw Mill River Parkway is pictured below. All commercial structures in the parkway system harmonize with their surroundings.

# Westchester County Motor Parkways—Boulevards in Open Country

A stretch of parkway near Worthington.

By C. H. VIVIAN

WESTCHESTER County, which adjoins New York City on the north, has one of the world's outstanding park and motor parkway systems. In their present state, these improvements represent expenditures of approximately $75,000,000; and further substantial sums are being spent annually in extending them.

The setting is excellently suited to the purpose. Nature generously endowed the area with streams, lakes, and verdure-clad hills. Moreover, she created a harbor at the mouth of the Hudson River a few miles away that predestined the building there of the nation's greatest city, with its attendant demand for outlying space in which a portion of its people might live and play. Westchester County has long been a favored locale for the estates of the wealthy; and in recent years it has attracted thousands of homeseekers who are content with a house, some open space around it, and pure fresh air to breathe.

The development of parks and roads is partly the cause and partly the effect of this migration from New York City. It is, in the final analysis, a quasi-commercial venture, for it is intended that it shall add to the desirability of the section as a place to live. Statistical data show that it is succeeding. The population of the county increased from 344,436 in 1920 to 520,947 in 1930, a gain of slightly more than 50 per cent. Concurrently with this growth, there was a vast accretion in taxable property. The assessed valuation jumped from less than $700,000,000 in 1921 to more than $1,800,000,000 in 1931, and the rise was more abrupt after 1925, the year in which the improvements began really to make themselves felt.

The building of the parkways is merely one manifestation of the continual northward movement of New York City. As the village that was founded as New Amsterdam at the tip of Manhattan Island grew into the modern Gotham, the establishment of additional parks kept pace. How fast this municipal extension has come about can be grasped if it is recalled that only 81 years ago Central Park was set aside in what is now mid-Manhattan. At that time, the streets from 59th to 110th, which are the park's southern and northern limits, existed only as lines on the map. Myopic persons of that day derided the action of the city fathers. The area, they said, was not only barren and rocky but so far out of the city that nobody would ever use it. Today this 840-acre tract probably is the most valuable piece of parkland in the world.

In the years that followed, New York not only enveloped Central Park but continued its march to the north. Fordham, West Farms, Morrisania, and other sections that had been farming country were annexed to the municipality. As the houses and business buildings crept up the island, the city authorities continued to reserve plots here and there for park purposes. In this manner, Van Courtlandt, Bronx, Pelham Bay, and other parks came into being.

About 40 years ago, Westchester County and New York City joined hands to correct insanitary conditions along the Bronx River which had led to many protests. This work was not finished until 1925. While it was primarily a sanitary improvement it transformed the lower Bronx River Valley from an eyesore into a thing of beauty. In order to control and protect the zone affected, the land was acquired and improved on either side of the stream, and a motor parkway constructed. As this undertaking neared completion, the change wrought by it began to attract homeseekers, and the officials of Westchester County saw the possibilities of a comprehensive parkway and highway system.

Thus it was that in 1922 the county launched a far-reaching program. Authority was obtained through the passage of a state law which created a commission of nine members invested with the power to borrow money and to issue bonds for the purpose of acquiring and improving lands. This body, the Westchester County Park Commission, has since that time invested roughly $63,000,000 of county funds and $13,000,000 of state funds in the furtherance of its work. In 1927 the number of commissioners was reduced from nine to six.

The activities under discussion constitute the major part in a comprehensive plan which will shape the future growth of the county—an area of 450 square miles. They make up but one phase of an effort towards orderly development. In other words, the county is predetermining what it will be like in a few years hence, when additional thousands will have been added to the population. Using known factors as a basis, the Regional Plan Association of New York estimates that by 1965 Westchester County will contain 1,313,000 persons, or virtually double its 1930 count. For several years, every square inch of the southernmost one-third of the county has been protected by zoning. Further evidence of this control that is being exerted over future development is that 23 out of 90 official planning boards in New York State are to be found in this county.

The park plan consists of the establishment of park preserves and their interconnection by motor parkways, whose distinguishing feature is that they are bordered on both sides by substantial widths of acquired land which is landscaped and improved. This not only enhances the appearance of the drives, which are the collaborative work of the Commission's engineers and landscape architects, but also insures their perpetual freedom from roadside blemishes such as billboards, refreshment stands, and the like. Necessary architectural appurtenances such as automobile filling stations, police headquarters, and restaurants are designed in conformity with the surroundings and are almost devoid of commercial appearance. Grade separation bridges of great beauty abound, the prevailing

**A swamp as it appeared in March, 1924. See the opposite page.**

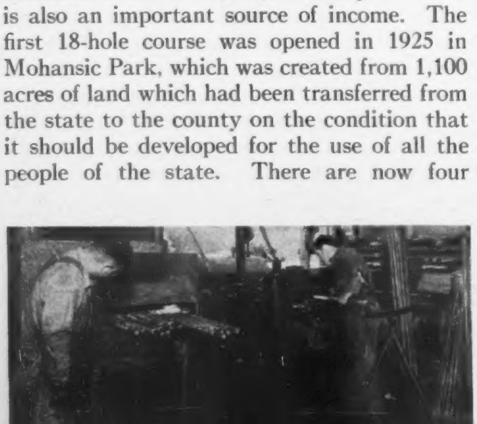
**Above—A gigantic puff of smoke from the blasting of 128 holes.**

**Six drillers with S-68 "Jackhamers" pose on an island of rock with Contractor Dan Deering.**

type being of concrete rigid-frame construction faced with native stone in varied architectural designs. The parkways are flanked by rustic guard rail of locust wood. Red cedar is employed for the standards of the lighting system which expedites night travel.

Park areas are designed to provide all ages and all classes with health-giving outdoor recreation and amusement. The facilities range all the way from picnic grounds to bathing beaches. At Rye, on Long Island Sound, there was opened in 1928 an amusement center which was visited by 3,400,000 persons in 1931. Those who wish merely to spend a quiet period in the open may find vast expanses of wooded country, essentially in its primitive state.

While the recreational and public-welfare benefits to be derived from the improvements are of paramount consideration, the Commission has been able to meet operating and maintenance expenses with the income received from rentals, concessions, and recreational fees. The greatest revenue producer is the amusement center at Rye, which has returned as much as $1,000,000 in a year. Golf is also an important source of income. The first 18-hole course was opened in 1925 in Mohansic Park, which was created from 1,100 acres of land which had been transferred from the state to the county on the condition that it should be developed for the use of all the people of the state. There are now four courses; and 204,978 rounds of golf were played on them in 1931.



**Putting new cutting edges on drill steels.**

Today, the park system controls 17,254 acres of land and 160 linear miles of parkways. The basis of the development is the acquisition of the required land, and this frequently involves the gathering and consolidation of numerous small plots. Up to April 30, 1931, a total of 4,143 parcels had been acquired, of which 3,432 had been obtained by purchase and 711 by condemnation. All told, more than $30,000,000 had been paid for real estate.

The nuclei of the system are, of course, the parkways; and work is continually in progress on their extension as well as on the improvement of the county and state highways, with which the parkways are closely coördinated. For the past several months there has been under construction a section of parkway approximately two miles long between Elmsford and Eastview that represents a continuation of Saw Mill River Parkway, one of the principal north-south units of the system. This work, which is designated officially as Contract 361, is in the hands of D. Deering Company, Inc., of Norwalk, Conn. The line of the road skirts the west side of a valley, and much of it is of side-hill construction. The preparation of a graded surface 70 feet wide called for the excavating of 184,000 cubic yards of material, of which approximately 80,000 cubic yards was rock. The contractor moved in the first of his outfit last December and began active work three months later.

As the route traversed virgin land, which was heavily overgrown in most places and which could be walked through only with difficulty, it was impossible to gain access to intermediate points to deliver corrugated pipe and other supplies for the placing of drainage structures prior to constructing fills. To obviate this difficulty and to open up the entire section, the first step was to run a power shovel through on the center line. Thereafter, work was started from the two ends and carried forward under two superintendents, each of whom has attempted to better the progress of the other.

Cuts through rock ranged up to a maximum of 30 feet on the uphill side, and fills up to 30 feet in depth were required. At one point, where a ravine crossed the line, the survey called for hauling in 31,000 cubic yards of material to span the low section. Virtually all material for fills was obtainable from the reduction of sections higher than grade line, so it was not necessary to borrow dirt from areas off the route.

Portable air compressors were well adapted to the requirements of the job, and the contractor standardized on these units. Seven Ingersoll-Rand Type 20 machines were used, six of them to supply air to sixteen rock drills.

Above—A portion of the rock broken by the blast shown opposite.

Parkway created from the swamp shown on the opposite page.

Portable compressors and rock drills massed in attack upon a 20-foot cut through hard ground.

and one to run the equipment for sharpening drill steels. Units of four different sizes were used, ranging in piston displacement from 120 to 310 cubic feet per minute and aggregating 1,615 cubic feet per minute. The Deering Company strongly favors the use of portable compressors and claims that the various sizes are so well balanced that the cost of running a "Jackhamer" is the same regardless of whether a 1-drill or a 3-drill compressor is used.

The drilling work was featured by the use of four Ingersoll-Rand Type S-68 "Jackhamers", which are known as 3-way drills. These are fitted with a 3-way throttle which permits varying the drilling speed. To accommodate the rate of drilling to the particular type of rock encountered, it is necessary for the drill runner only to admit the desired quantity of air by means of a simple control. Eight standard S-68 drills also were used, these being of the same type that was used with success in the extensive excavations required for Rockefeller Center in New York City. The performance of all these drills elicited favorable comments from Dan Deering, president of the contracting firm. "I believe that on this job we are getting the maximum amount of work from each cubic foot of air", said Mr. Deering.

Down-hole drilling was practiced, the spacing of the holes depending, of course, upon the thickness, character, and condition of the rock to be removed. Holes were drilled as deep as 20 feet. As much as 20,000 linear feet of hole was put in in one month. Ingersoll-Rand hexagonal, hollow drill steel of 1-inch section was used. Fifty-eight per cent semi-gelatin dynamite was used for blasting, and firing was done with an electric battery.

Loading was handled by three gas-powered P. & H. shovels, two of them with 1-cubic-yard dippers and the other with a 1½-cubic-yard dipper. The hauling was done by eleven 5-ton Mack and Autocar trucks. Three Caterpillar tractors—two "Thirty's" and one "Sixty"—were employed for miscellaneous duties. They supplied motive power for portable compressors and other equipment over rough ground and, equipped with bulldozers, served to move and level excavated materials dumped by the trucks.

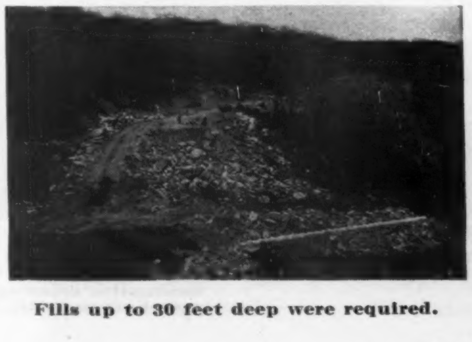
The blacksmith shop was located on the north end of the job, and two trucks were used to haul drill steel between it and the various points of work. Steels for the southern half of the work had to be taken in and brought out by way of the southern end of the new route. From that point to and from the shop they traveled an existing road roughly parallel to the new highway. Included in the blacksmith shop equipment were an Ingersoll-Rand Size 40 drill-steel sharpener, a No. 26 oil furnace, and a No. 8 pedestal grinder. Compressed air was supplied by a Type Twenty 7x6 portable compressor. As many as 8,000 drill-steel bits were reconditioned in a month.

As previously noted, the grade for the road measures 70 feet from shoulder to shoulder. The plan is later to build a 40-foot concrete highway in the center of this, which will leave 15 feet on either side of the paved strip for grass, rustic guard rail, lighting standards, and other standard features of such parkways.

Mr. Deering assumed personal direction of the entire job, with Alexander Wilson and Howard Gingel serving as superintendents, each in charge of work on one half of the line. Jay Downer is chief engineer for the Westchester County Park Commission; Edward Anderberg is engineer for the western division, in which this contract is located; and H. H. Bayliss represents the Commission as resident engineer.

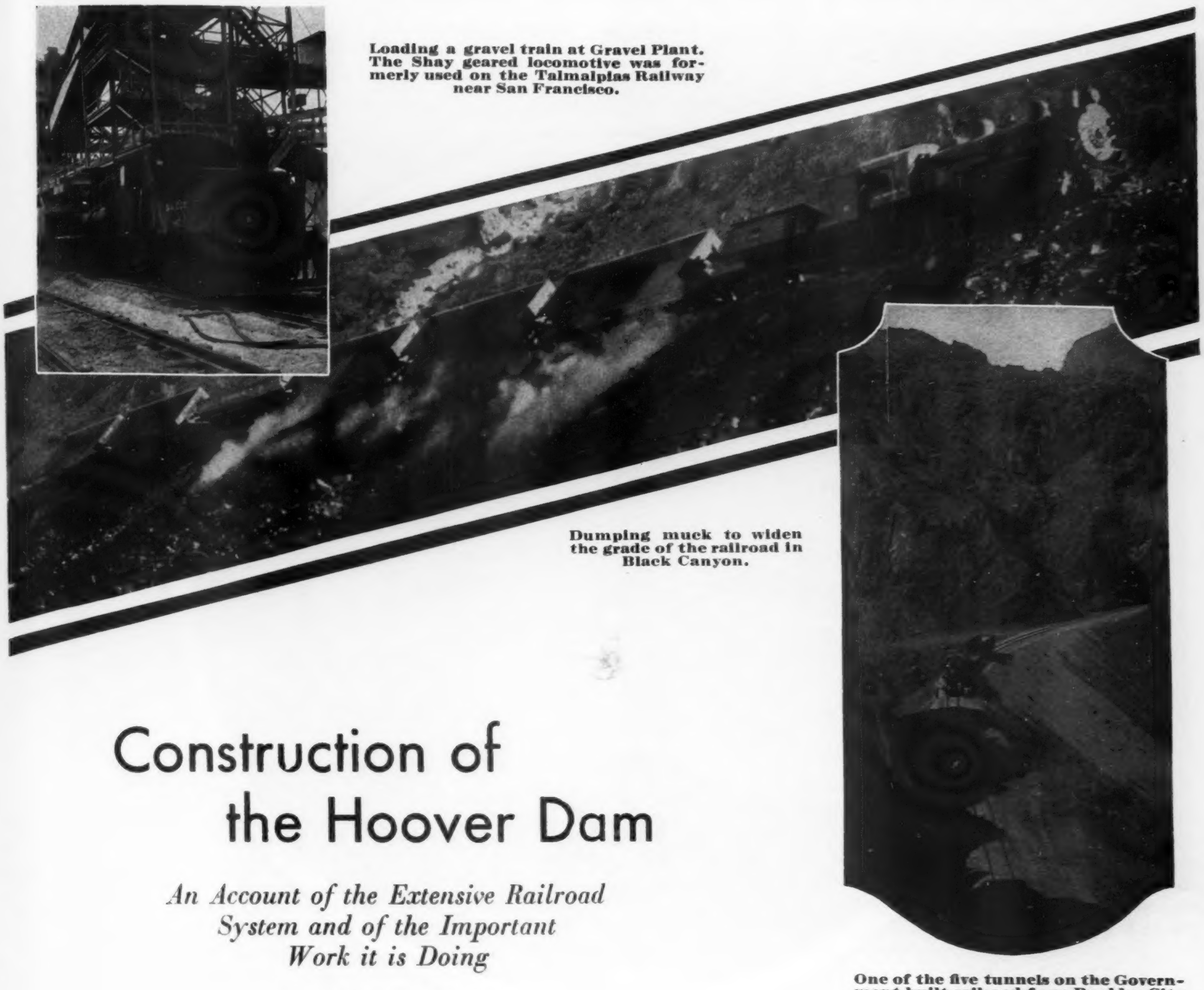
The personnel of the Westchester County Park Commission includes: Arthur W. Lawrence, president; William J. Wallin, vice-president and treasurer; Cornelius A. Pugsley, Henry R. Barrett, J. Mayhew Wainwright, and Gerard Swope.

Future contracts will extend the Saw Mill River Parkway northward, with Katonah as its ultimate destination. For purposes of further development, another parkway reservation has been established along the adjacent secluded Sprain Brook Valley.



Fills up to 30 feet deep were required.


Above—Muck train, with spoils from the upper ends of the diversion tunnels, passing the contractors' River Camp en route to a dumping area a mile upstream. Below—Mikado locomotive crossing the Colorado River on a trestle bridge and hauling 700 tons of gravel seven miles from the Arizona Gravel Pits to Gravel Plant, on the Nevada side.



Loading a gravel train at Gravel Plant. The Shay geared locomotive was formerly used on the Talmalpias Railway near San Francisco.

Dumping muck to widen the grade of the railroad in Black Canyon.

One of the five tunnels on the Government built railroad from Boulder City to the rim of Black Canyon.

# Construction of the Hoover Dam

*An Account of the Extensive Railroad System and of the Important Work it is Doing*

**NORMAN S. GALLISON***

THE transportation of materials and equipment that must be moved in the course of building the Hoover Dam is so huge an undertaking as to constitute almost an industry in itself. It involves the construction by Six Companies Inc. of twenty miles of railroad at a cost of nearly $1,000,000, as well as the operation of this system and a 9½-mile line built by the Government—close to 30 miles in all. It is estimated that $2,000,000 will be spent for operation, making the total cost of railroading activities to the contractor $3,000,000, or about 6 per cent of the bid price on the entire work. This does not, of course, take into account the expenditure of $455,509 for the construction of the Government line.

Over these rails during the next five or six years there will move a volume of freight greater than that on any main-line railroad in the West. Carefully compiled figures indicate that 33,000,000 tons of live load will be carried, and that this will result in the movement of approximately 440,000,000 ton-miles of dead and live load combined. The locomotives will travel an aggregate distance of 700,000 miles and will haul 63,000 trains whose combined 600,000 cars would make a solid line 4,500 miles long.

Virtually all of this railroad is built and in operation, in fact, thousands of tons of materials have already been transported. Like all other phases of the contract, the railroad runs 24 hours a day, seven days a week. The operating force numbers 71 men, and 60 others are engaged in track construction.

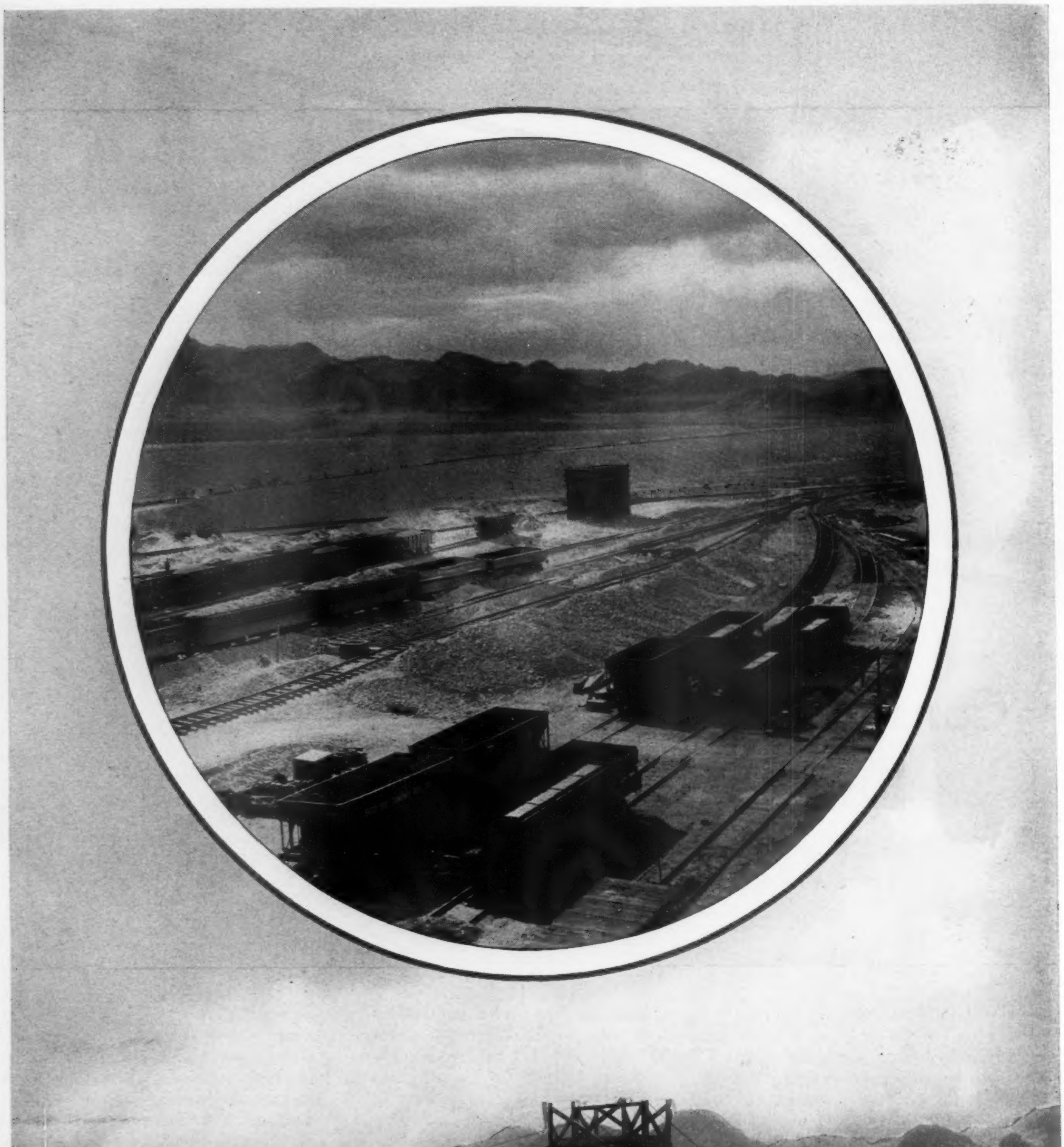
The accompanying map shows the railroad lines; but it furnishes little evidence of the difficulties that were met in their construction—difficulties that arose from the rocky and precipitous character of the surface in the vicinity of the dam site and from the great difference in elevation of the points that had to be connected.

Before the award of the contract was made to Six Companies Inc., the Union Pacific Railroad had built a 23-mile line extending from a point near Las Vegas, on its Salt Lake-Los Angeles system, to the site where Boulder City was later to rise like a mushroom. A 400-car switching yard was provided, as were also sidings to the locations that had been selected for warehouses and other structures that would require direct trackage. The Government had also placed a contract for the construction of tracks from Boulder City to the Nevada rim of Black Canyon directly above the dam site. Upon its completion, this line was turned over to Six Companies Inc. for operation. Its terminus has now been designated Himix, as it is there that the contractors will locate the high-level concrete mixing plant which will provide concrete for all that portion of the dam and its appurtenances extending above elevation 720 feet.

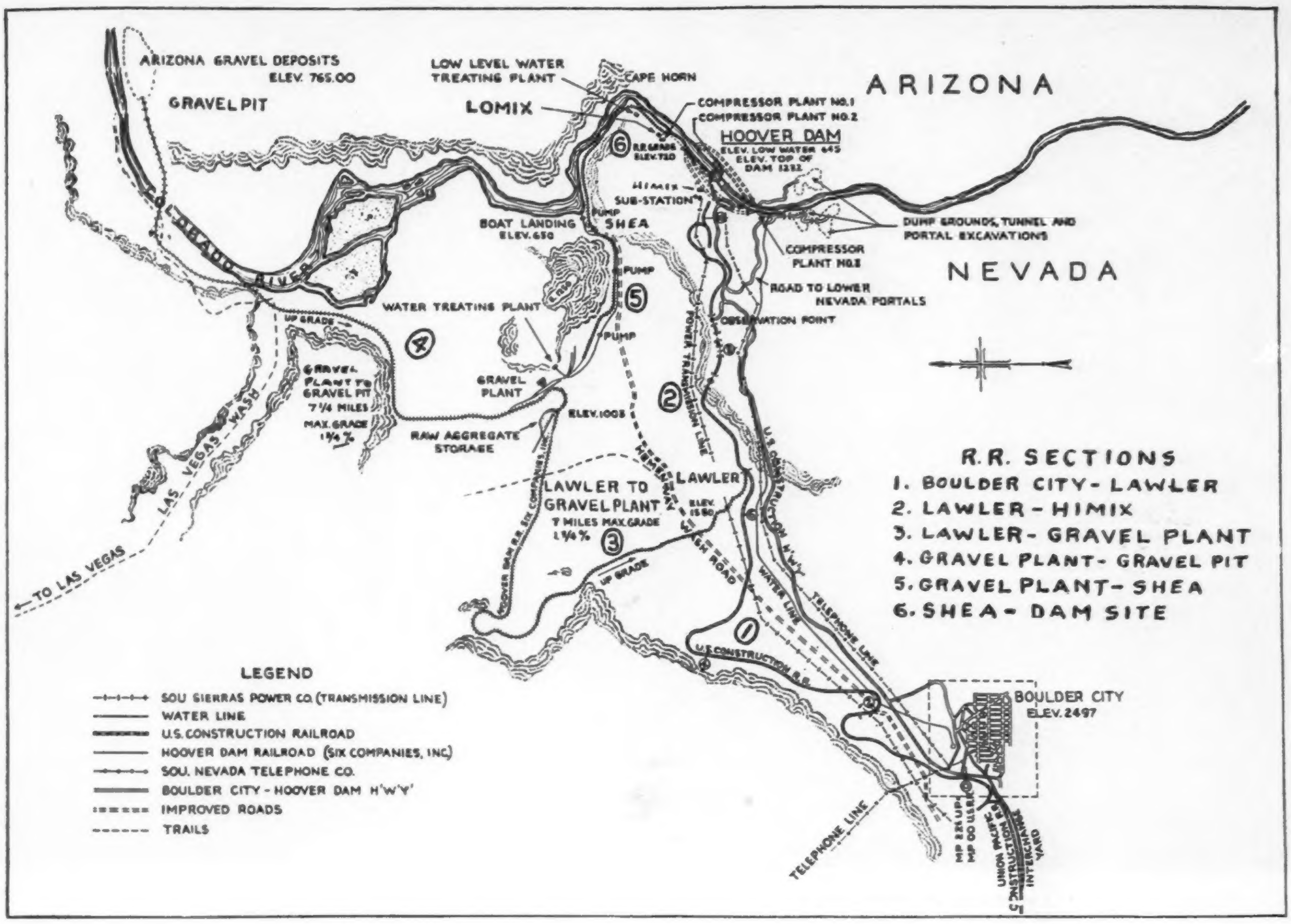
At a point 6.25 miles out from Boulder City on this Government-built railroad, the dam contractors started work on the remainder of the system that would be required. This junction point was at first known as Government Junction, but has more recently been named Lawler, after H. J. Lawler, a director of the contracting firm. All of this

*Public and Press Relations Division, Six Companies Inc.

*Ninth of a series of articles on the Colorado River and the building of Hoover Dam.*



**Above—View of the railroad yard at Gravel Plant. Nearly 500,000 tons of raw concrete aggregates are in the background. Below—Track-laying crew of the subcontractors at work on Six Companies Inc. railroad in Hemenway Wash.**

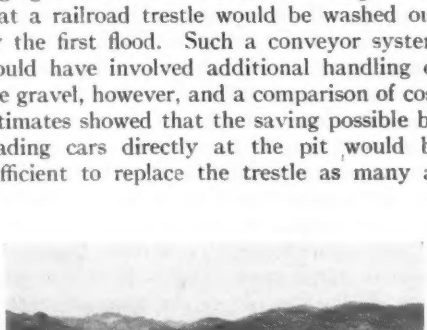



**Sketch map of the area affected by the Hoover Dam construction activities showing the railroad system, principal highways, power lines, and other structures provided to facilitate the rearing of the dam.**

railroad is of standard-gauge, 90-pound-rail construction, with Oregon fir ties laid sixteen to the rail length and ballasted. Except for that portion extending upstream from the dam site for three miles along the canyon wall, the line was constructed by subcontractors.

The section from Lawler to Gravel Plant is almost seven miles long, and descends in that distance from an elevation of 1,580 feet to one of 1,003 feet. Its maximum grade is 1.75 per cent. Gravel Plant is itself a junction, and is both figuratively and literally the center of the railroading operations. From this station, which is situated in Hemenway Wash about two miles from the river, the line runs upstream seven miles to Gravel Pit station at the Arizona Gravel Deposits and downstream five miles to the dam site. The upstream section crosses the Colorado about a mile and a half from the gravel deposits, this being the only portion of the trackage that is in Arizona. The rails descend from Gravel Plant to the river bank on a maximum grade of 1.75 per cent, reaching approximate water level in 3½ miles and then following the stream to their objective. The terminus at the gravel pits is at elevation 765.

The river is crossed on a wood-pile-and-trestle bridge 1,140 feet long. All concrete aggregates to be used in the construction activities at the dam will move over this span, and it is estimated this will involve 60,000,000 live ton-miles of operation. A suspension bridge supporting a belt conveyor was originally planned for carrying these aggregates across the stream, it being feared that a railroad trestle would be washed out by the first flood. Such a conveyor system would have involved additional handling of the gravel, however, and a comparison of cost estimates showed that the saving possible by loading cars directly at the pit would be sufficient to replace the trestle as many as four times during the life of the contract, should that become necessary. A railroad bridge was accordingly built; and, to minimize the loss in case of flood, it was anchored at each end with a large cable.



**Railroad equipment outside shops.**

From Gravel Plant toward the dam site, the railroad follows Hemenway Wash on a 3.4 per cent maximum grade a distance of two miles to Shea, a station named for Charles A. Shea, director of construction for the entire Hoover Dam job. This station is at the upper end of Black Canyon; and from that point downstream three miles to the dam site the line is known as the Canyon Railroad. This section was built by Six Companies Inc., and was the most costly of all the railroad construction because the rails skirt the canyon wall throughout their course. The excavation was almost entirely in rock; and two tunnels, each more than 1,000 feet long, had to be driven. From Shea to the terminus, the tracks run level at elevation 720. The lower end, above the dam site, is 80 feet higher than the river. For two miles between Shea and Lomix, where the low-level concrete mixing plant is located, the line is double tracked. This railroad system, which ranges in elevation from 2,497 at Boulder City to 720 in the canyon, comprises 36.7 miles of trackage, including double track, yard track, and sidings. A shop building 252 feet long has been constructed in Hemenway Wash and equipped for the care and maintenance of rolling stock.

**Cutting a shelf for rails in the perpendicular wall of Black Canyon. A 1,000-foot tunnel was bored through the rock at the right. The fill at the bottom was made with muck from the adit to the diversion tunnels on the Nevada side.**

For operating purposes, the line is divided into three sections. The first subdivision extends from Boulder City to Lomix, the second from Gravel Plant to Gravel Pit, and the third from Lawler to Himix. The system is run under the standard railroad code, the Union Pacific book of rules being followed in general owing to the fact that the crews work in and out of the interchange yard with that line at Boulder City. A single train-order form is being used. Dispatching is done by telephone.

Thirteen locomotives are in use. Three Mikado type and four consolidated-type steam units were purchased from the Union Pacific. There are also in service a 10-wheel, 70-ton steam locomotive, a Shay 40-ton steam locomotive, and four Plymouth 30-ton gasoline locomotives. Rolling stock consists of 50 bottom-dump hopper cars, 34 new-style 30-cubic-yard Western dump cars, 32 old-style 30-cubic-yard Western air-dump cars, six flat cars, and one tank car. Miscellaneous equipment includes one American gasoline locomotive crane, two Diesel Industrial Brownhoists, and one Jordan spreader.

The principal transportation problems involved in the Hoover Dam contract are: First, moving excavated materials from tunnels, dam-foundation excavations, and cofferdam excavations to disposal areas; second, moving cement, sand, and gravel for concrete; and, third, moving miscellaneous construction materials and Government materials consigned to the power house. This class includes mechanical and electrical machinery.

Much of the materials in the first class has already been moved. Of the total amount of muck moving involved in the consummation of the contract, approximately three-fourths will be handled by trucks and one-fourth by railroad. All the second and third classes of materials will be transported by rail. Even though most of the material excavated from the diversion tunnels and related works was truck hauled, nevertheless vast quantities of it were carried by railroad. In general, excavated materials from the lower end of the working zone are handled in trucks and those from the upper end are transported by rail an average distance of 2.32 miles to disposal areas in Hemenway Wash. It is estimated that, during the life of the contract, a total of 2,933,743 tons of muck will be moved by rail. As many as 600 cars, containing 12,000 cubic yards of dirt and rock, have been hauled over the Canyon Railroad in a day. The schedule drawn up for the year 1932 calls for the haulage by rail of an average of 2,300 cubic yards of muck daily.

While the items included under the first and third headings are important from the railroad standpoint, the transporting of the materials for concrete will overshadow them. Sufficient sand, gravel, and cement must be hauled to make 4,293,400 cubic yards of concrete, all of which will be poured during the six years from 1932 to 1937, inclusive. During the two years 1935 and 1936, more than 3,250,000 cubic yards will be prepared and used. The schedule fixes July, 1935, as the probable maximum month, and estimates that 171,000 cubic yards will be poured during its 31-day span. Concreting of the diversion tunnels and related structures began last spring under a schedule which calls for the pouring of from 2,000 to 33,000 cubic yards monthly during the remainder of the year.

The sand and gravel which are requisite ingredients in the concrete will all come from the Arizona Gravel Deposits; and it will be necessary to transport 8,586,000 tons of these materials an average distance of 7.25 miles to the gravel plant, where they will be screen-

**Gravel Plant station, the "union depot" of the line.**

**The blast which put an end to "Cape Horn", a jutting cliff that impeded railroad construction at the upper end of Black Canyon. Eight tons of dynamite, loaded in scores of drill holes, brought down 160,000 cubic yards of rock.**

ed and washed. Moreover, it will be necessary to have all the needed aggregates out of the pits by 1936, because by that time the gravel deposits will be under the water that will have been backed up by the portion of the dam then in place. It is estimated that 5,618,000 tons or, roughly, three-fourths of the total supply will be moved by December, 1934. These materials are being transported to the gravel washing plant and run through it as fast as it will handle them. They are then being placed in stock piles to be used as required. The gravel treating plant and the stock-pile areas are high enough so that they will still be above the shore of the lake that will have been created by 1936.

**A muck train at Lomix, a mile above the dam site.**

The moving of the sand and gravel from the stock piles to the two concrete mixing plants will be another major railroading task. The quantity to be hauled to the low-level mixing plant, a distance of 4.75 miles, is 3,033,730 tons; and that to the high-level plant, a distance of 10.4 miles, is 5,124,730 tons. In addition, all the cement required will have to be transported from Boulder City. This will involve moving 374,586 tons a distance of eighteen miles to Lomix and 632,646 tons a distance of 9.65 miles to Himix. This cement will arrive in bulk in railway cars, which will be emptied at the mixing plants and then returned to Boulder City. At the height of concreting operations, the Himix plant will require 25 carloads or 1,150 tons a day. This is equivalent to 6,250 barrels. The Lomix plant will need about one-third this quantity at its peak activity. Miscellaneous materials such as reinforcing steel, structural steel, high-pressure gates, valves, pipes, fittings, and machinery for the power house will have to be moved from Boulder City down to the dam site and will aggregate 400,000 tons.

Gravel and sand hauling is being done by trains consisting of ten cars. A 5-cubic-yard Marion dragline loads the materials at the pit. Although the cars are rated at 30 cubic yards capacity, they are carrying an average of 35 cubic yards. The material weighs about 3,800 pounds to the cubic yard, so that 700 tons are transported on each train trip. En route, the locomotive must negotiate grades up to 1.75 per cent. A round trip requires about 2½ hours. During the past summer from 200 to 250 cars a day were being delivered to the gravel plant. Some of the screened and washed aggregates are now being used for the concrete lining of the diversion tunnels, which calls for their transportation from Gravel Plant to Lomix.

From the foregoing account it can be gathered that Six Companies Inc. have tackled their railroading problem with the same foresight, thoroughness, and engineering soundness that have characterized their other manifold activities pertaining to the record-breaking Hoover Dam undertaking. As yet the time of really heavy traffic has not arrived; but the facilities are ready to handle it when it does come. Meanwhile, crews are limbering up for the days when they will haul a volume of freight that might arouse the envy of any railroad executive in the country.

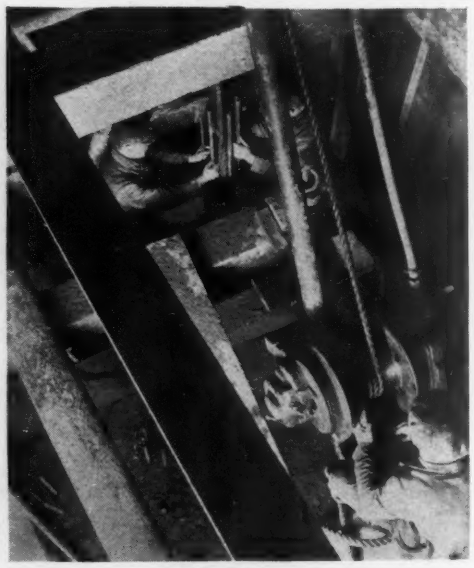
The Six Companies Inc. railroad is being operated under the supervision of T. M. Price, superintendent. Mr. Price designed and directed the construction of the gravel-screening plant. For a number of years he has been with the Kaiser Paving Company, one of the member firms of the Hoover Dam coalition. G. A. Allen is trainmaster and chief dispatcher. L. A. Grubbs is dispatcher on what is known in railroad parlance as the second trick, and T. J. Kelly serves in the same capacity on the third trick.

# Sinking Piling for Bridge Foundations in Limited Headroom

D. Y. MARSHALL

A DESCRIPTION of a method of forming reinforced-concrete piling *in situ* was published in *Compressed Air Magazine* for October, 1929. It was pointed out in that article that this process is particularly suitable for use where piles have to be placed under conditions which afford little headroom.

An interesting example of the application of the method was presented in connection with the construction of a railroad bridge in the south of England which is now nearing completion. A new by-pass road is being constructed from Hampton Court to join the Portsmouth road, and has to pass under the Southern Railway embankment, making necessary a new bridge in place of the existing brick arch of only 22 feet span. This is too narrow for the new road, which has a width of 60 feet. In order to construct the new abutments it was decided to cut two trenches behind each of the existing abutments, spanning each of the openings with temporary steel girders to carry the varying railway loads.



**Workmen placing a pile in restricted space.**

Trial pits were dug and revealed a 2-foot layer of water-logged sand at a depth of 6 feet. Below this, ballast was found until blue clay was revealed at a depth of 20 feet. After careful consideration it was decided that the use of piling would be advisable in view of the heavy reactions due to increased loading and span.

Both of the trenches through the embankment behind the existing bridge had to be heavily timbered and strutted to withstand the pressure exerted by the embankment with its rolling load. Some 9x3-inch sheeting was used for the sides, as well as 12x12-inch walings and struts. Consequently, the site was extremely congested, and headroom of only 21 feet was obtainable from the underside of the temporary girders to the top of the piles. It was imperative that railway traffic should not be interrupted, and this ruled out the ordinary method of pile driving as there was neither headroom nor space for a piling frame in the trenches.

The problem was solved by resorting to pressure piles which can be sunk both within congested sites and where there is limited headroom. In addition, there is the advantage that no vibration is caused during the piling operations. By this system, a 13-inch boring is made for each pile, the hole being lined with steel tubes as boring proceeds. These tubes are of an average length of 5 feet and, therefore, could be passed through the struts and joined up as they were sunk, giving a lined hole of any desired depth.

Boring was carried out with the usual well-boring tools—a shell or sand pump being used to withdraw the ballast and sand and an auger to bring up the blue clay. The handling of these tools was facilitated by "Little Tugger" hoists, the air for their operation being supplied by Type 20 portable compressors.

Having settled upon the depth, each hole was cleaned out and the steel reinforcement lowered into position. The reinforcement consisted of six ⅞-inch round bars tied together with ¼-inch helical binding at 4-inch pitch. The section of the reinforcement was made heavy, as the piles might be subjected to bending by reason of the horizontal thrust on the abutments. It was also important that the reinforcement should be in one piece; and, consequently, each steel skeleton had to be assembled in a vertical position between the struts—individual bars being lowered from the railway line above.

After the steel reinforcement was fixed, a 1:1½:3 mixture of concrete was poured into the hole, filling about 6 feet of the tube. The concrete was mixed fairly wet so that it would flow easily through the reinforcement. The tube was then gradually raised by a "Little Tugger" hoist, the air pressure being kept up the whole time so that the concrete, on leaving the tube, would be forced out against the sides and thus fill all the cavities, penetrate the interstices, and form a dense concrete pile with high skin friction. As each tube section was brought up and unscrewed, more concrete was added, and this was continued until the pile was flush with ground level. The steel reinforcement was left protruding so as to bind it into the superstructure.

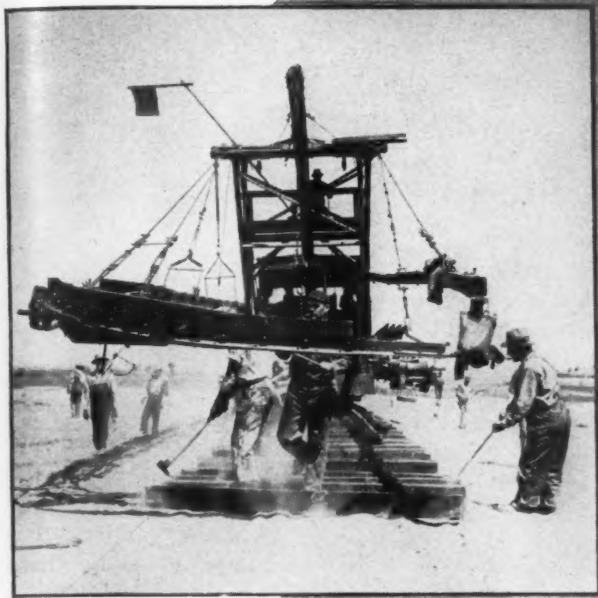
To ascertain the length of pile required to carry the load, a pile was sunk at one end of the abutment to a depth of 19 feet 6 inches and tested for its bearing capacity before the contract was started. A load of 30 tons was first applied to the pile and left for 24 hours, the settlement being carefully recorded. Another load of 5 tons was then added, but practically no further settlement took place. As a result of this test it was finally decided to use a 20-foot pile.

There are 66 piles under each abutment arranged in three rows spaced 2 feet 8 inches and 3 feet 7 inches apart. The piles in each row are spaced on 3-foot 8½-inch centers. A maximum of six rigs was operated simultaneously—one side being finished first so that work on that abutment could proceed. The bars projecting from the piles were bent over, and old rail sections placed between the piles as reinforcement for the pile caps. On top of this foundation, concrete abutments were constructed with artificial stone blocks on the exposed surfaces.

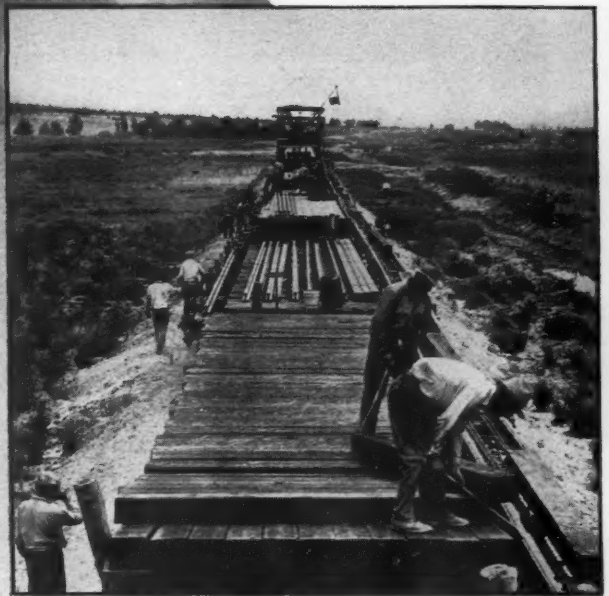
This contract was successfully carried out by the Pressure Piling Company, Ltd., of London, to whom we are indebted for the facts contained in this article.

Photos, Civil Engineering, Ltd., London

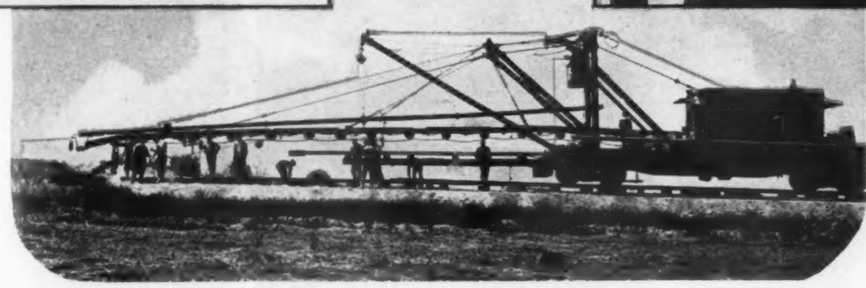
**General view of the bridge which was lengthened without stopping traffic on the railroad overhead.**



At rail head, showing the front end of the pioneer car that is equipped for the laying of rails and ties.



Looking forward from the rear of the rail train where men are busy loading ties on one of the conveyors.



Side view of pioneer car. Note boom in the act of lifting a rail from the near conveyor.

# Western Railroads Build Two Hundred Miles of New Trackage

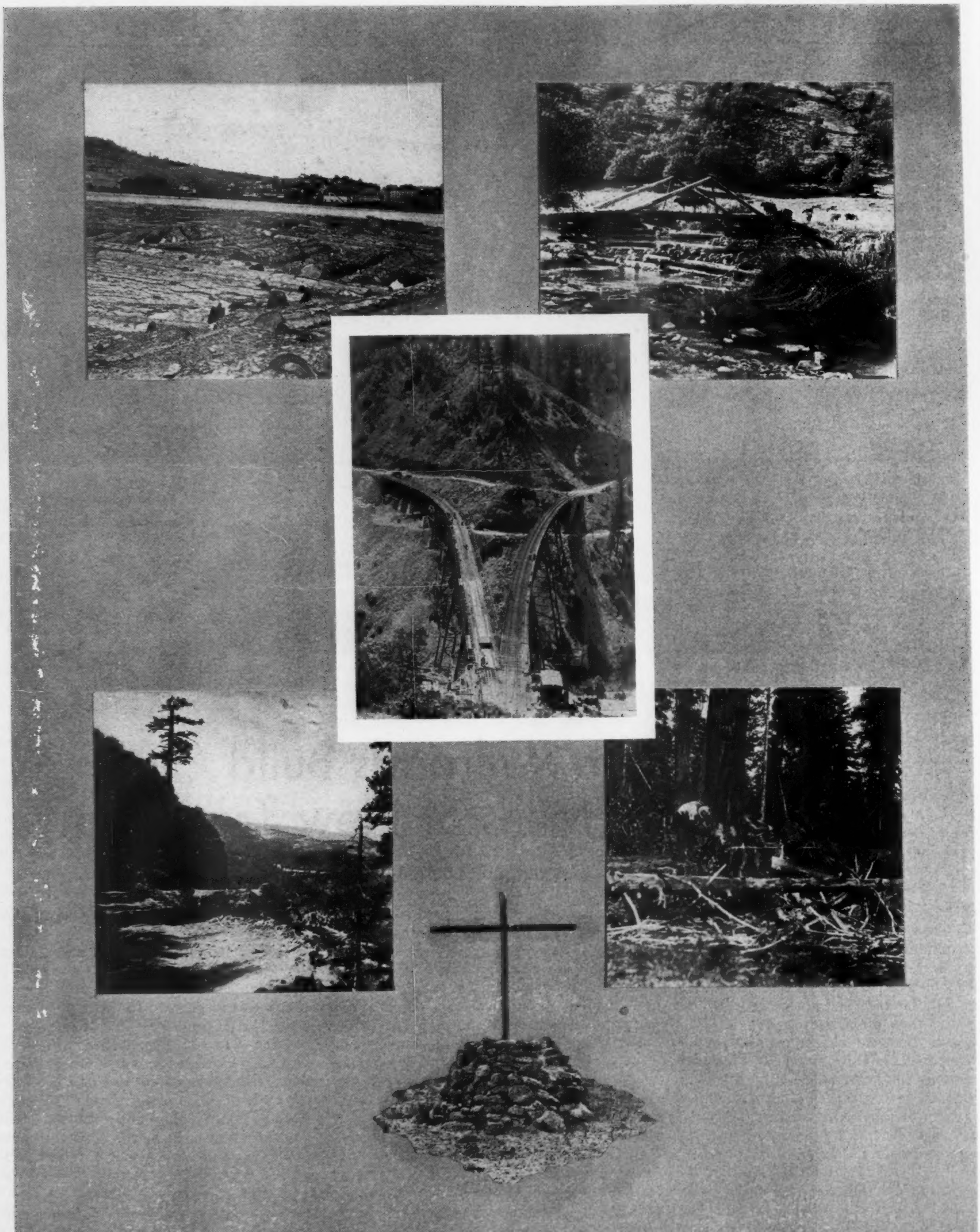
**LAWRENCE A. LUTHER**

IN THE early fall of the year 1852, a band of 65 Oregon bound emigrants was coming up the "old inland trail" through the Klamath country. Little is known concerning the members of that party except that they were farmer folk, for they had not turned aside to follow the then all-pervading lure of California gold but had determined to possess rich homesteads in Oregon. They had passed the summer in traversing 1,000 miles of desert lands, and their clothing and entire train were literally saturated with floury alkaline dust that had been as inseparable from the caravan as the Biblical pillar of cloud.

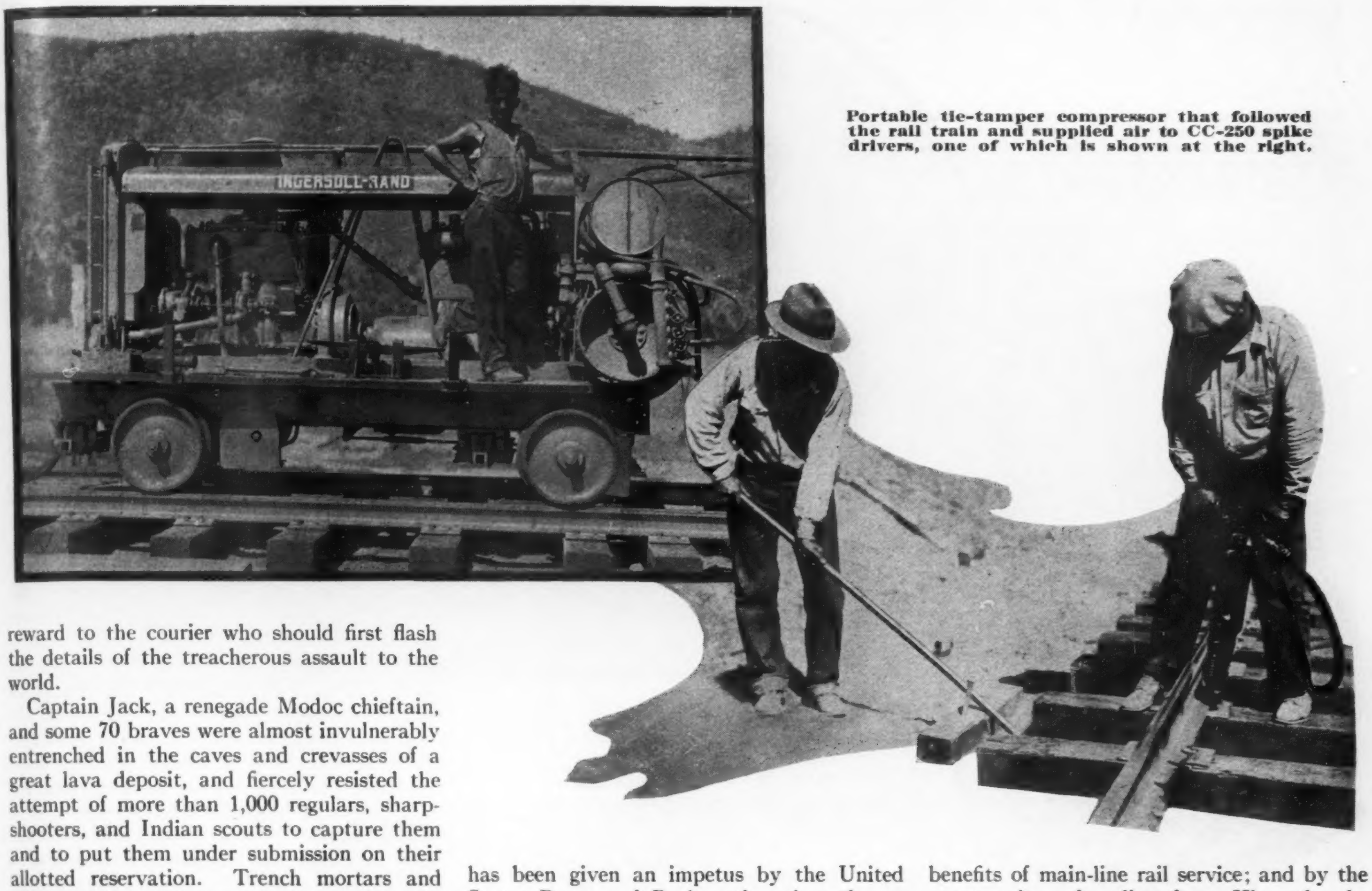
Where that old trail comes down to what was once Tule Lake, scrub juniper fights for a foothold in the lava rock; and in those days the shore supported a dense growth of tules or bulrushes that grew higher than a man's head. It was rough going, and the cattle were galled and worn; but the interminable sagebrush and dust were gradually giving way to verdure and abundant water in the foothills of the Cascades. Mount Shasta loomed up, a snow-covered milestone; and the land of their desire lay just across the mountains. It was this location that a large and hostile band of Modoc Indians had selected for its ambush; and the unsuspecting party of pioneers, so the story is handed down, was annihilated except for two girls in their teens who were held captive and one badly wounded man who escaped.

This was altogether typical of travel through that region during the "fifties" and "sixties". It was referred to as the "Dark and Bloody Ground"; and early historians estimated the toll taken by the Modocs from wagon trains at more than 300 lives. John C. Fremont, the "Great Pathfinder", met some of those savages on his scouting trip of 1846; and it was only by reason of the famed strategy of Kit Carson that he and his companions did not suffer a more serious loss of life. It is well that the larger western tribes were not so insatiable as the Modocs in collecting scalps and loot, for otherwise the settlement of the Pacific Coast might have been seriously retarded.

Journeying through this inland California and Oregon country remained not only slow and arduous but dangerous until comparatively recent years. In 1873, for example, when their neighbors—the Klamaths, the Shastas, and the Rogue River tribes—were peaceably settled on Government reservations, the Modocs were setting the stage for their last headline performance. On a day in April of that year, a hotly contested point-to-point race was being run between the western shore of Tule Lake and Yreka, Calif., the nearest telegraph station 70 miles away. The trail through the Shasta country resounded to the hoof beats of horses cruelly ridden, for two prominent citizens and a distinguished general of the United States regulars had been murdered. They had been enticed into the enemy camp under a flag of truce with the pretext of parleying for peace; and the field correspondents of the leading Pacific Coast dailies were offering a sizable



**Reading down from left to right—Stretches along the Klamath River that serves both the lumberman and the cattleman. Where the new road meets the main line of the Western Pacific at Keddie. Section of the principal trade route between Ager and Klamath Falls in the "eighties". The lumber industry is a thriving one in the region traversed by the Great Northern-Western Pacific rail connection. Canby's Cross, commemorating the death of Gen. Edward R. S. Canby in the Modoc War.**




**Portable tie-tamper compressor that followed the rail train and supplied air to CC-250 spike drivers, one of which is shown at the right.**

reward to the courier who should first flash the details of the treacherous assault to the world.

Captain Jack, a renegade Modoc chieftain, and some 70 braves were almost invulnerably entrenched in the caves and crevasses of a great lava deposit, and fiercely resisted the attempt of more than 1,000 regulars, sharpshooters, and Indian scouts to capture them and to put them under submission on their allotted reservation. Trench mortars and other special equipment had been brought to the scene by horse-drawn vehicles from San Francisco and Vancouver; for this was true frontier country 60 years ago. The most telling shot during the conflict proved to be a shell that failed to explode until the curiosity of an old Indian prompted him to demonstrate the firing mechanism by drawing the pin with his teeth. Some estimates place the number of white men killed in this struggle at 400; and it is indubitably true that Uncle Sam never spent more blood and money in subjugating so small a band of desperadoes. Here were savages, men who deemed their vested rights in their ancestral hunting ground along Lost River to be as real as those of any white man in his home.

At the time of the Modoc War this region not only was devoid of facilities for travel and for communication by mail or wire but it could not boast of any center of population that might have been classed a town. Some 40 souls lived at Linkville, a trading post located on that stretch of the Klamath River running between Upper and Lower Klamath lakes. The steady and rapid growth of this hamlet to the status of an industrial and business metropolis—the Klamath Falls which we know today—is indicative of the varied resources of the section which it serves.

Within the comparatively brief span of about 60 years, Klamath Falls has become one of the most active centers of the lumber industry in the United States; and during the past decade agriculture has made rapid strides in the surrounding country. Farming has been given an impetus by the United States Bureau of Reclamation through various irrigation projects which it has gradually brought to completion. The draining of Lower Klamath and Tule lakes has made a large acreage available for cultivation. The bed of Tule Lake, especially, with its 94,000 acres of fertile soil within reach of abundant water, is well suited to the growing of grain and forage crops. Stock-raising and dairying are important phases of the farming industry; and the quality and yield of the potato crop, which is increasing annually, might make older and better-known potato-producing sections look to their laurels.

With the completion of the old Siskiyou line of the Southern Pacific Railroad in 1887, bringing Klamath Falls and the adjacent territory within easier reach of other large cities, the resources of the region began to attract attention. But all the commodities still had to be freighted in from Ager, Calif., over some 60 miles of difficult mountain road. Traveling was then mainly done on horseback—the only passenger conveyances being the great stagecoaches which have been so well described by Mark Twain as "imposing cradles on wheels". Local historians boasted of the daily stage service that was maintained; and now, as one rides swiftly over modern highways, one can still catch glimpses of some of the winding trails over which the people of the "eighties" journeyed slowly by stagecoach or in the saddle.

When the Southern Pacific Company completed its Natron Cutoff over the Cascades in 1926, Klamath Falls began to enjoy the benefits of main-line rail service; and by the construction of a line from Klamath, the Southern Pacific recently effected a junction east of Reno with its San Francisco to Ogden Overland Line. As a result of this improvement, the run for eastbound shipping has been shortened and the heavy grades over the Sierras have been largely eliminated.

Not long ago Klamath Falls celebrated the completion of another new rail line which links the Great Northern system with the Western Pacific. This route has scenic charm as well as economic value. Leaving the beautiful Columbia River near The Dalles, and following the picturesque and rugged canyon of the turbulent Deschutes River to Bend, Oreg., the road traverses the rapidly developing Klamath country and a section of inland California that is but little known or advertised. This territory still largely retains the characteristics of the frontier, and invites the sportsman or lover of virgin forest land. There one may enjoy intimate glimpses of the western mule deer and of other forms of wild life, or one may catch—and lose—large specimens of trout and other game fish which abound in nearly all the lakes and watercourses from the Columbia to the Feather. The new construction is expected to develop and to enhance the value of the extensive region traversed; and it ranks, in a national as well as in a local sense, with projects of major importance.

The rail link was built jointly by the Great Northern and the Western Pacific, and is more than 200 miles long. It consists of an extension of a branch line of the Great Northern from

**The 5½x5-inch portable that served also as a tractor in bringing rails in contact with expansion shims.**

**Tightening joint bolts with a 99-C pneumatic track wrench. Two of these tools were supplied with air by the portable shown above.**

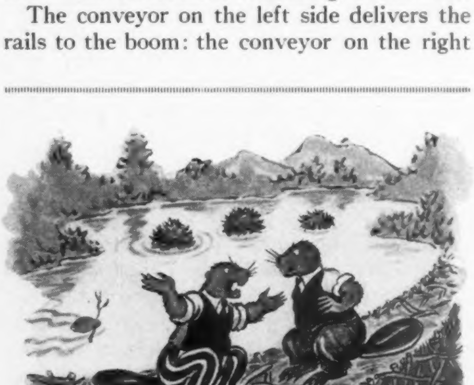
Bend, Oreg., southward to Bieber, Calif., at which point the Western Pacific took up the work and carried it through the Sierra Nevada Mountains to a junction with its main line at Keddie in the Feather River Canyon. The latter part of the program was in charge of the W. A. Bechtel-Utah Construction Company; the section between Bend and Klamath Falls was awarded the Hauser Construction Company; and A. Guthrie & Company, Inc., was given the contract for the stretch between Klamath Falls and Bieber. The rugged nature of the country necessitated the building of numerous bridges and tunnels, and this involved the excavating of large quantities of rock. Much of this work was sublet to other western contractors.

The rail-laying operations, as done by A. Guthrie & Company, Inc., presented features of unusual interest. For that purpose the contractors used somewhat elaborate equipment which was designed and constructed by their own engineers. This consists of a train headed by a "pioneer" car on which is mounted a power plant, a boom for placing rails, and a set of conveyors, one on each side, for bringing forward rails and ties. The conveyors extend the length of as many flat cars as are needed to carry the supplies, and are secured to the cars by means of brackets resting in the stake pockets. Fifteen to 20 cars sufficed to haul the materials for laying from 1½ to 2 miles of track. This train was taken to rail head—the locomotive remaining at the rear.

The conveyor on the left side delivers the rails to the boom: the conveyor on the right side carries the ties forward and drops them in proper position and fairly accurately distributed ahead of the rail-laying crew. This is accomplished by a manually operated gate in the tie conveyor and by an ingeniously arranged semicircular device for turning the ties as they are discharged. The conveyor chains and rollers and the rail-laying machinery are driven by a gasoline motor on the "pioneer" car. Only one bolt per joint is tightened ahead of the train; and the rails are temporarily held to gauge with tie-rods.

On this extensive project, A. Guthrie & Company, Inc., augmented their equipment with pneumatic tools designed for tightening joint bolts and for driving spikes. Immediately behind the rail train, the crew spaced the ties, inserted the tie plates, and tightened the joint bolts. In conjunction with this latter work it is necessary to correct the position of every rail so as to make allowance at each joint for expansion and contraction due to changes in temperature. This cannot be accomplished with precision ahead of the train, as the application of the brakes tends to move the rails. Heretofore it has been the practice to pry each rail back by hand to contact with a shim held in the joint. But on the Great Northern job it was discovered that a 5½x5-inch self-propelled tie-tamper compressor, provided with a suitable cable and rail grip, could be used as a tractor to bring the rails against the expansion shims. The compressor could do this without interfering with its regular service—that of supplying air to two 99-C bolt wrenches. Because of its flexibility, precision of control, and the absence of clutches, air-motor drive lends itself well to this and other work. The fact that uniform tension can be given each bolt by regulating the air pressure is of importance where track must remain some time without ballast, in which condition there is the ever-present danger of kinking in hot weather. Six of the twenty ties under each 39-foot rail were gauge spiked by hand behind the rail train. The remaining ties were spiked with CC-250 pneumatic spike drivers drawing air from a 10x8-inch portable compressor.

The air-operated rail-laying machinery mentioned did not complete the list of modern pneumatic equipment used on the job—in fact, was just a small part of it. Large quantities of earth and rock were excavated with modern rock drills, which have done so much to reduce not only the cost of big construction undertakings of this kind but also the time required in which to carry them through to conclusion. The present project in its entirety represents an investment of $15,000,000. The expenditure of so large a sum in railroad improvement is highly inspiring, especially at this time when lack of confidence more frequently dictates retrenchment. It voices the faith of the builders in the future of the Pacific Coast.



**"No, let's wait until after election before we call it Hoover Dam."**

# American Mines Go Modern

**Coal streaming up from the bowels of the earth and, in the inset, an electric haulage motor that replaces many mules.**

## *Mechanization and Improved Methods Cut Costs Per Unit of Production*

**C. MORAN**

ROBOTS are replacing the pick-and-shovel miner of former days. Mines that once swarmed with underground workers are now operated mechanically with fewer men and larger output. A unit of mineral is being dug at a lower cost than ever before in this country. The mechanical equipment of all classes of mines is becoming more efficient, and more skilled labor and better technical supervision are required. Many of these improvements are the result of research on the part of both Federal and State bureaus of mines coöperating with private enterprise.

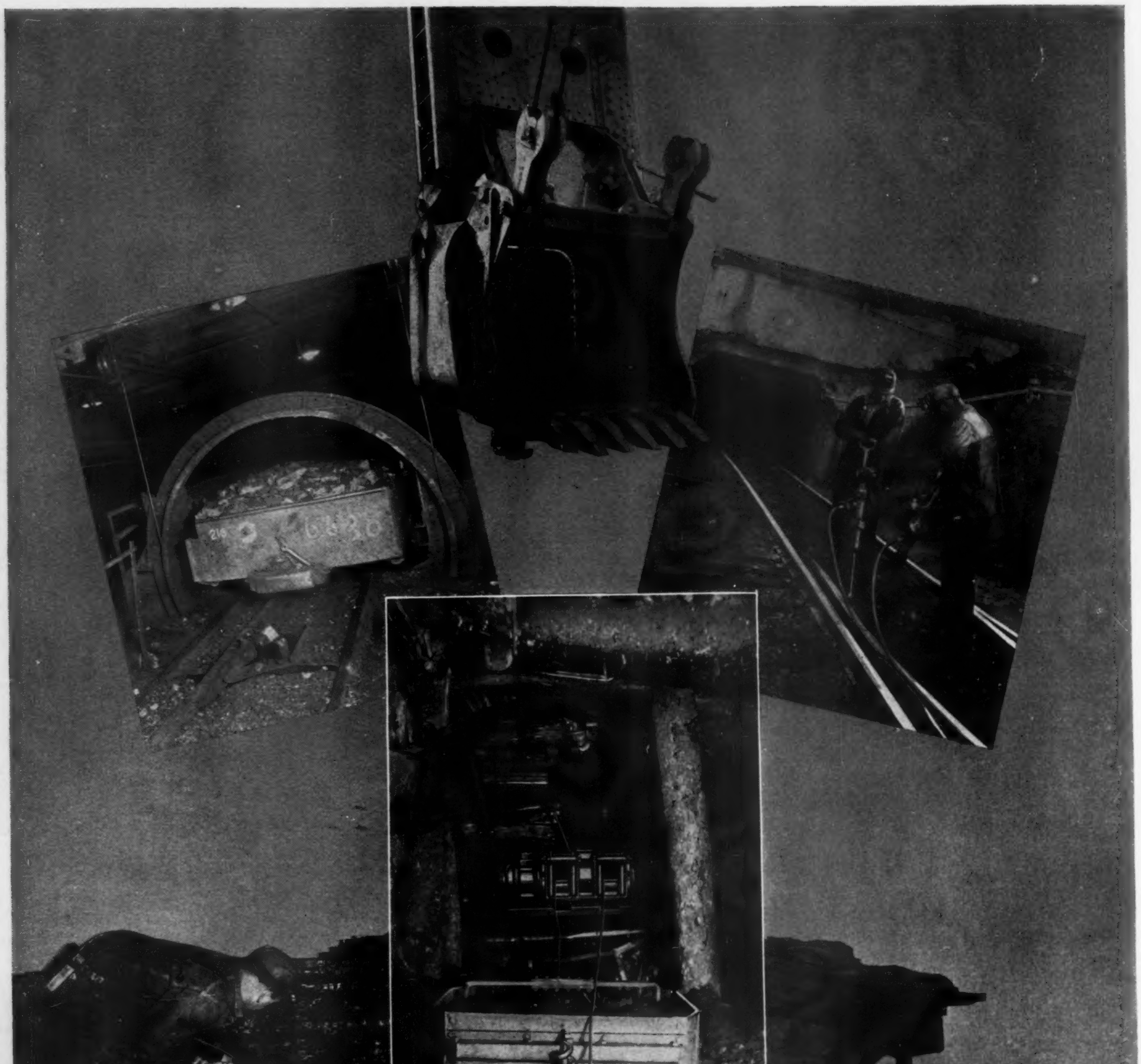
An Arizona copper mine, for example, has increased its production from 7½ tons of ore per man-shift to almost 17 tons per man-shift, and uses only ⅓ pound of dynamite per ton. Another Arizona copper property has raised its output per man-shift from 4½ to 10¼ tons. An open-cut copper mine in Utah has stepped up its production from 11 tons to 28¼ tons per man-shift with the use of only ⅒ pound of explosives per ton. A gold mine in Alaska has improved its mining methods to such an extent that it now produces 47 tons per man-shift and employs less than 12 pounds of powder in doing so.

Electric power is transmitted long distances to mines, and there are fewer local fuel-burning power plants. Electricity is used from the surface to the mine faces in coal mines. The mule is disappearing from coal-producing properties. Mines equipped with electric haulage now produce 86 per cent of our soft coal. Electrically driven mine-car compressors supply air close to the points of use. They are dustproof; and provision is made for cleaning the air before it is compressed. Explosion-proof motors are available for gaseous mines. Such compressor cars can be had arranged for self-propulsion by air motors.

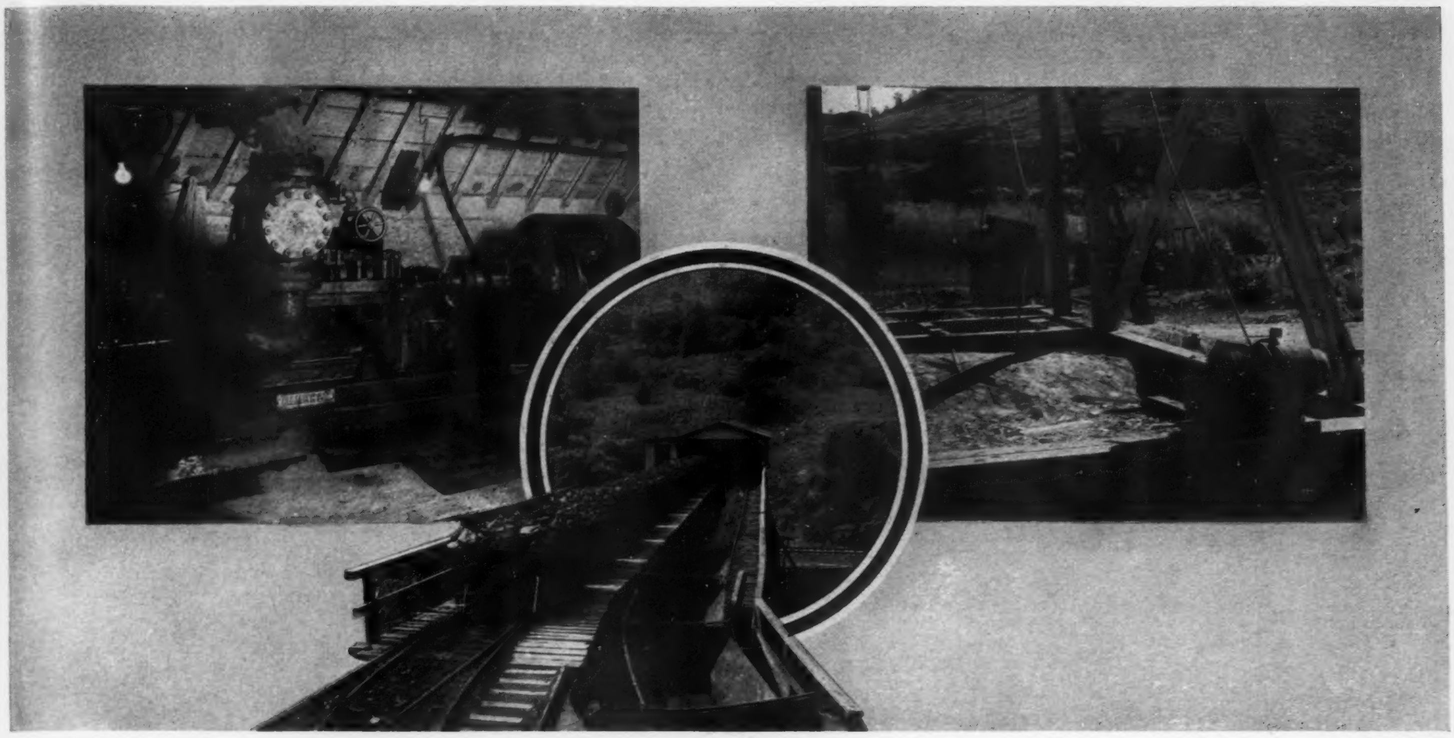
Light-weight, powerful, air-operated tools known as "Pickhamers" perform more efficiently the tasks in coal mines once allotted to the hand pick. Some bituminous properties now mine their entire output with these tools. Endless belt conveyors—usually driven by electric motors, but by air motors in gaseous mines—transport coal from the faces to the main haulageways. The tamping of ballast under ties with air-driven tampers makes possible faster and safer haulage. Roller bearings on mine cars reduce friction and aid in the movement of greater tonnages per train. Rotary dumping devices empty cars of their contents without the need of uncoupling trains and allow the use of solid-body cars instead of those with side or end gates.

Thirty years ago a 2,000-ton-per-day coal mine was a large producer; today, 5,000- and 10,000-ton mines are not uncommon. All permanent mine structures have been given greater stability. Concrete has replaced other materials in the construction of overcasts, stoppings, and portals. Steel tipples on concrete foundations have supplanted wooden frameworks on masonry footings. By means of improved methods and equipment engineers have increased the percentage of coal recovery from as little as 40 per cent in 1880 to an average of 65 per cent today. Progress has been made in the preparation of anthracite for the market by enlarging breakers and introducing new systems for both wet and dry cleaning coal.

The firing of 50,000 pounds of explosives at one time was formerly regarded as an outstanding feat in quarrying or mining operations. Explosives engineers have learned how to fire upwards of 500,000 pounds safely in bringing down a whole season's supply of rock or ore. Recently 600,000 tons of ore, which outcropped on a hillside, was loosened by a single blast. One hundred and sixteen bore holes in series and from 54 to 60 feet deep were



The three upper views show, from left to right, a rotary dump for ore cars; the dipper of a huge stripping shovel; and pneumatic tools tamping ballast under railroad ties at a mine portal. Below, in the same order, are pictured, an air-driven "Pickhamer" mining coal; an electric double-drum slusher hoist in an iron mine; and a modern drifter drill in action.



**Left to right—Two 5-stage centrifugal pumps which lift water 1,494 feet at the rate of 820 gallons a minute; a coal train emerging from a mine adit; a Motorpump, on a line lowered and raised by an air hoist, which handles water encountered in sinking a shaft.**

loaded with powder and fired simultaneously with electric detonators. Last March more than 1,000,000 tons of stone was blasted in a Michigan quarry. An area of more than twenty acres was penetrated with 4,031 drill holes; loaded in eight days; connected with nearly 38 miles of instantaneous fuse; and fired successfully. The entire job was handled without a lost-time accident.

New explosives that utilize gases instead of powder have been developed. Old types of black powder which produced a long, hot flame and which caused many fatalities from secondary explosions in dusty atmospheres have been replaced by explosives that give rise to a short, cool flame and thus minimize the danger of mishaps. Ingredients have been added to dynamite that make for a lower freezing point and thereby largely eliminate accidents in connection with thawing it out in cold weather.

Both electric and compressed-air hoists are simplifying and speeding up the handling of coal and metallic minerals underground. They supply power for scrapers which quickly and inexpensively move vast tonnages short distances from points of extraction to haulageways, conveyor systems, or chutes. These hoists also handle timbers, tools, pipes, and other materials, spot cars, and perform other useful services.

Where loading is done directly into cars underground, mucking machines have to a considerable extent supplanted hand-shoveling. Large-capacity centrifugal pumps which operate against high heads are taking the place of reciprocating pumps for handling drainage water. Smaller, portable units such as the Motorpump, which operate efficiently in any position, are being adopted for shaft-sinking and prospecting operations.

In metal mines, hand-drilling went out of fashion long ago, and compressed-air drills which strike upwards of 2,000 blows a minute do the work. Lighter, faster drilling machines are being developed all the while. They are handled by one man; and the cumbersome 2-man drill which prevailed twenty years ago is becoming a curiosity.

There is still work to do for the old-type blacksmith, but ingenious machinery is lightening his burdens. Drill steel is now almost universally sharpened by machinery; and the machine-forged bits drill so much better than hand-formed ones that it is economical to install a sharpener even where but one rock drill is used regularly. Delicate instruments are available to control heat-treating, thereby making the tempering process a matter of exactness. Oil-fired furnaces have sounded the doom of the traditional forge. Air-operated grinders can be had which insure true ends on drill-steel shanks with consequent longer life and lower breakage of drill steel and rock-drill pistons.

Steam is still used for hoisting in most of the deep metal mines, but electricity is coming into greater use for this purpose all the while in shafts of lesser depth. Oil engines in large operations and gasoline engines in smaller ones are performing many services formerly handled by steam.

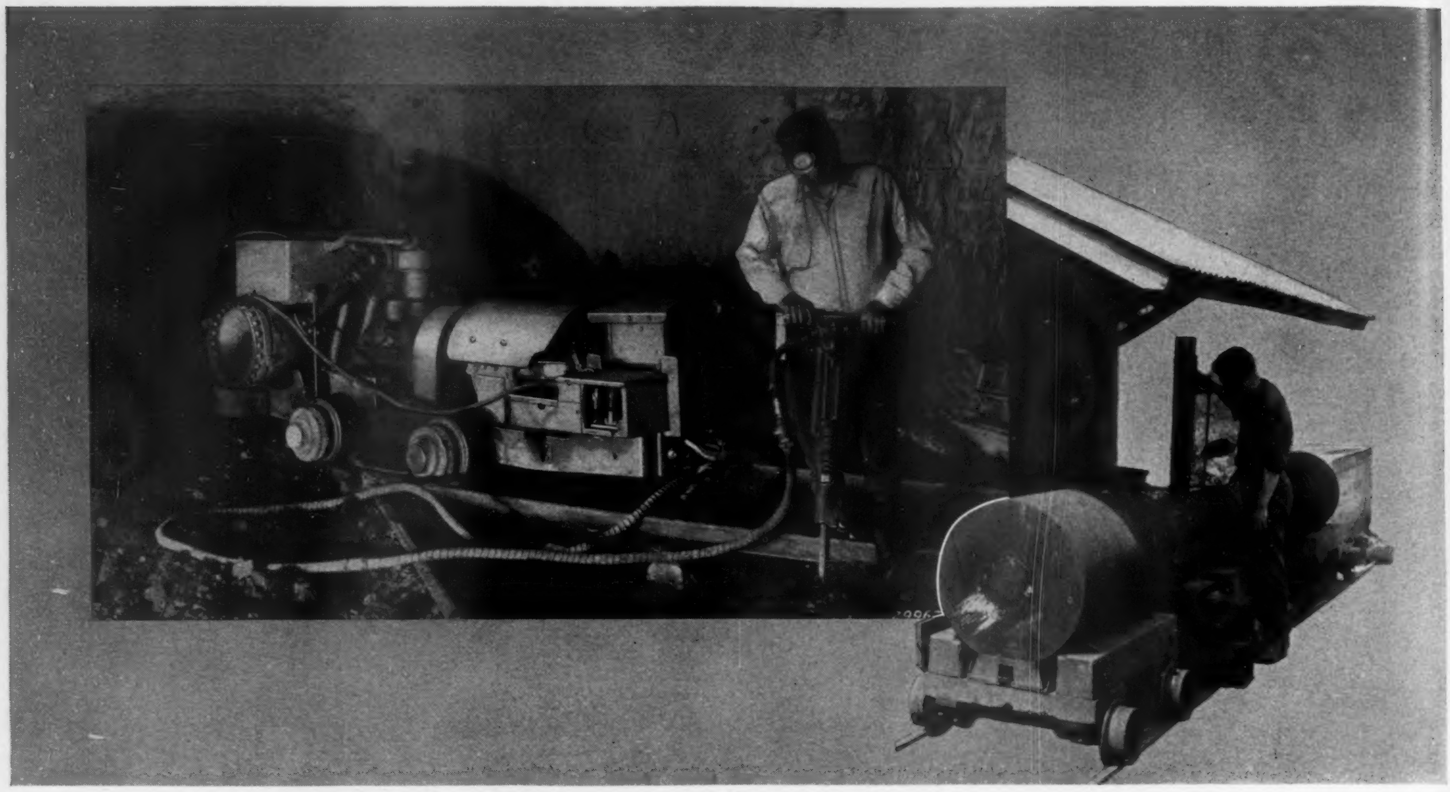
Stripping as a method of mining coal dates back to the time when the overburden was removed by pick and shovel, loaded into wheelbarrows or carts, and dumped. Some of the early wheelbarrow runs and dumps can still be seen in the anthracite districts of Pennsylvania. When the overburden was too heavy to remove by hand, horses were used to draw plows and slip scrapers. Where the top covering was unusually heavy, wheeled scrapers were employed.

Strip mining has increased to the point where 20,000 men are engaged in it in normal times. Coal-stripping was started near Danville, Ill., in 1866, and there were also early operations at Pittsburg, Kans. Bituminous coal is now mined by this method in twenty states—the individual mines ranging in capacity from a few hundred to several thousand tons a day. Electric stripping shovels up to 15 cubic yards capacity, 3-cubic-yard electric loading shovels, and trains made up of dump cars ranging from 15 to 40 cubic yards capacity, are some of the features of bituminous strip mines. A few years ago one shovel removed 1,800,000 cubic yards of material from a coal seam in Indiana in one year, exposing 360,000 tons of coal.

The first steam shovel was introduced in the iron range of Minnesota in 1897. In 1906 similar equipment was adopted for mining copper ore in Bingham Canyon, Utah. Since these beginnings, the mining of coal and other minerals by stripping or open-pit methods has increased to the extent that during an average year approximately 19,000,000 tons of coal, 24,000,000 tons of copper ore, 32,000,000 tons of iron ore, 150,000 tons of bauxite, and 2,700,000 tons of pebble phosphate are produced in this manner in the United States. These quantities aggregate 78,000,000 tons; and it is estimated that 4 tons of overburden are moved for each ton of mineral output.

More than three-quarters of our nonferrous ores are treated by flotation milling, a comparatively recent development that has given value to vast tonnages of low-grade and complex deposits which previously could not be handled at a profit.

Improvements in ferrous metallurgy tend towards either increased quantity or im-



**A mine-car compressor supplying air to operate a paving breaker and, at the right, apparatus used by the United States Bureau of Mines for testing explosives.**

proved quality. The use of larger and mechanically better blast furnaces has added much to the output of pig iron per furnace. The development of efficient turbo-blowers for this service has been a contributing factor in these advancements.

In the fire metallurgy of lead, the preparation of the fine portion of the blast-furnace charge by sintering, saving of volatilized products by baghouse or electric precipitators, and better refining methods for lead bullion are outstanding developments.

The retort, in which all zinc was produced prior to the World War, now has the electrolytic plant as a growing rival. The success of the electrolytic process is attributable to the production by flotation of high-grade zinc concentrates from complex ores, to the ease of handling residual products, and to the constant demand for processes involving less human labor.

The use of electricity in metallurgy has increased rapidly. It is being applied to the refining not only of lead, copper, and zinc, but also of the rarer metals. The ferro-alloys were largely developed in the electric furnace; and those containing tungsten, chromium, molybdenum, cobalt, nickel, and vanadium have become of great industrial importance in the past 30 years. Tin has recently been refined electrolytically. Aluminum is almost entirely a product of the electric furnace.

The prospector can now summon to his aid scientific methods and instruments that depend for their efficacy upon definite principles of geology. Ores with magnetic or electrochemical properties are being located by means of detectors which use direct, continuous, or alternating current having a wide range of frequencies extending upward through the audible to radio. Materials that differ in density and elasticity are detected by seismometers and torsion balances.

Magnetic surveys made recently in the copper regions of Michigan have readily disclosed the direction or strike of formations. Faulted or broken areas were located; the direction, throw, and magnitude of faults determined; and questions regarding the correlation of beds, thinning and lensing of formations, and general structural conditions were answered. In one area the formation was followed more than five miles by using magnetic instruments above ground.

Geophysical experts explain that a mass of magnetic ore disturbs the magnetic field locally, and that magnetic needles or magnetometers disclose variations from normal. By analyzing the results of such inquiries, the presence, extent, and approximate depth of certain deposits can sometimes be determined. This type of geophysical prospecting is, however, suitable only for detecting the presence of an abnormal excess or a deficiency of magnetic material in the earth.

Oil-bearing sections near the Gulf of Mexico are being explored by the use of seismometers or earthquake recorders that register the speed of shock waves produced by exploding charges of dynamite 6 feet in the ground. Waves from a charge of 150 pounds can be detected six miles from the point of explosion. Sound travels approximately 1,100 feet a second through air, about 6,000 feet through rock near the surface, and still faster farther underground. In some salt domes the speed is said to reach 16,000 feet a second. Quick arrival of the shock wave is an indication of the presence of salt domes in the area between the explosion and the recording instrument.

## SINGEING MACHINES FOR THE ELECTRICAL WORKER

SINGEING apparatus have been devised to help the electrician remove insulation from wires, cords, and cables of all kinds, as he is so often called upon to do in the course of his work. Knives, scissors, special pliers, or similar implements are generally utilized to perform this delicate operation; but there are drawbacks to their use—namely, they are apt to damage the wires and, because they must be handled with care, are wasteful of time.

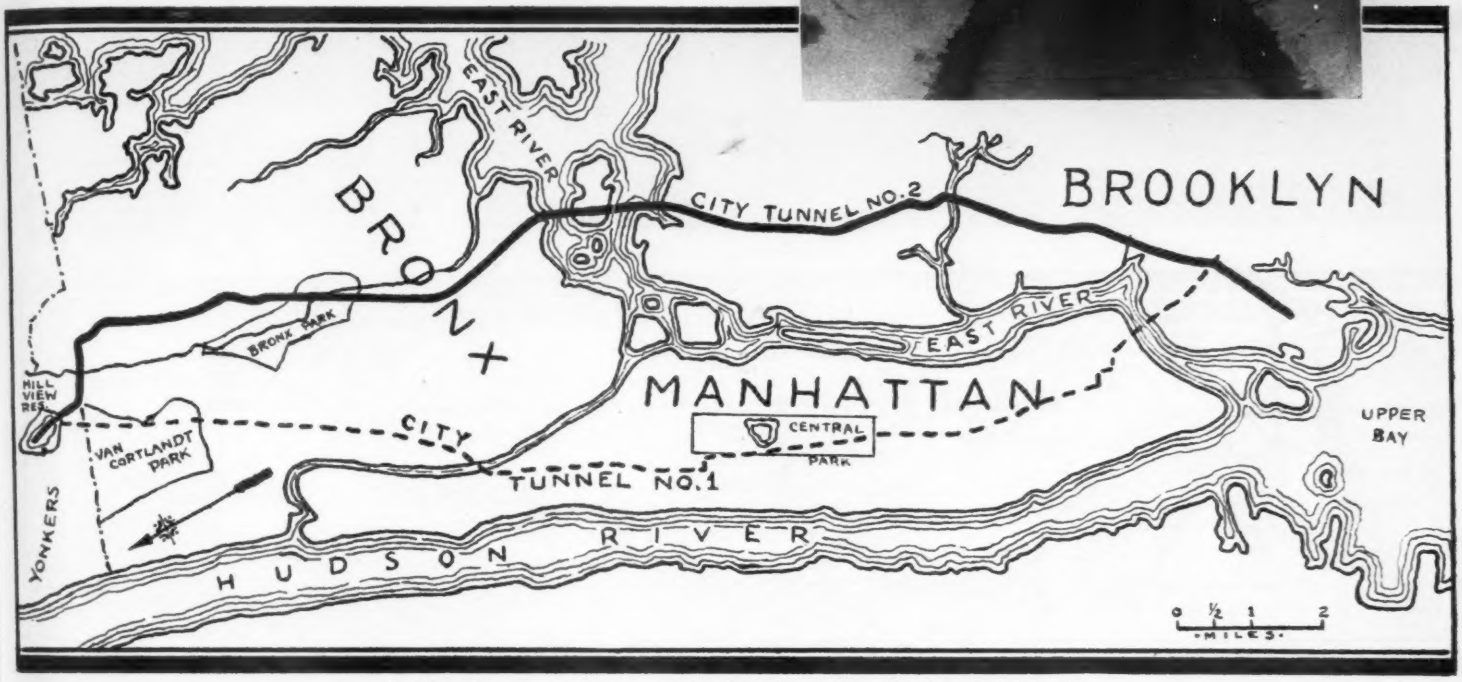
The singeing machine is a Swiss invention and comes in two types, one for light and the other for heavier forms of insulation. Both are easily portable. In the case of the former, the insulation is burned through instantaneously and almost as though a knife had been run around the cord: in the case of the latter, the insulation is singed both circumferentially and lengthwise.

The equipment is electrically operated, and consists in the main of two rods of a special alloy that are kept at red heat by means of a transformer. The rods are made so that they can remove the insulation from two wires or cords simultaneously. When the wire or wires are properly spotted on the lower rod, the upper one is brought down in contact with them by the movement of a lever. There it remains for at least one or two seconds, or until the insulation has been effectually burned through. The duration of this period is timed according to the resistance of the electric wires. A cooling current of air is passed between the rods and the fingers of the operator to protect them from the heat.

# Pumps Speed Grouting of 20-Mile Tunnel Under New York

*New Methods Prove Successful in Sealing Huge Bore Which Will Augment Distribution of Water*

ALLEN S. PARK




**On the above map the new tunnel is shown in solid line and the old one in dotted line. At the top is a section of the completed bore.**

UNUSUALLY high efficiency and speed in grouting a concrete-lined tunnel through rock are being obtained in the 20-mile water distribution bore now under construction in New York City. The work is being done with direct-acting pumps, which were originally purchased for handling water in sinking the shafts required to facilitate excavating the tunnel. Since the driving of the tunnel constitutes one of the largest jobs of its kind ever undertaken, the general features of the enterprise will be briefly presented before the grouting operations are described.

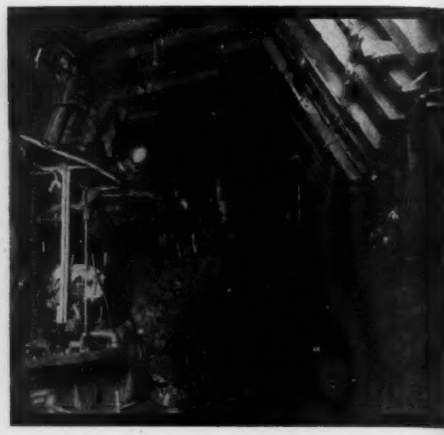
The tunnel is officially designated as New York City Water Tunnel No. 2, and is being driven for the Board of Water Supply of New York. It will extend from the distributing reservoir near Yonkers southward under the boroughs of Bronx and Queens into Brooklyn, passing beneath the East River *en route*. Near its southern terminus it will join a similar tunnel, which passes under Manhattan Island and the Bronx and which was constructed as a part of the Catskill water system started in 1905. Together the new and old tunnels will form a continuous loop which will permit routing water from the reservoir through either side to any one of the four principal boroughs of the city. This will make it possible to close off a section of the conduit for inspection or repairs without affecting the use of the adjoining sections, and will insure an uninterrupted supply of water.

The tunnel is being driven through solid rock at a depth ranging from 380 to 780 feet below the surface. It is 105,280 feet long, or almost 20 miles. The excavation varies from 19 to 25 feet in diameter in the rough. The finished tunnel is circular in cross section. Slightly more than 90 per cent of it will have an interior diameter of 17 feet. Of the remainder—totaling 10,211 feet in length—approximately two-thirds will be 15 feet and one-third will be 21 feet in diameter.

The entire job was let in one contract to Patrick McGovern, Inc., of New York, on a bid of nearly $43,000,000. Work was started in March, 1929, and is to be finished within 65 months from that date, or by October, 1933. Such rapid progress has been made to date, however, that completion is now a matter of only a few months. The working force employed has at times reached as high as 3,000 men.

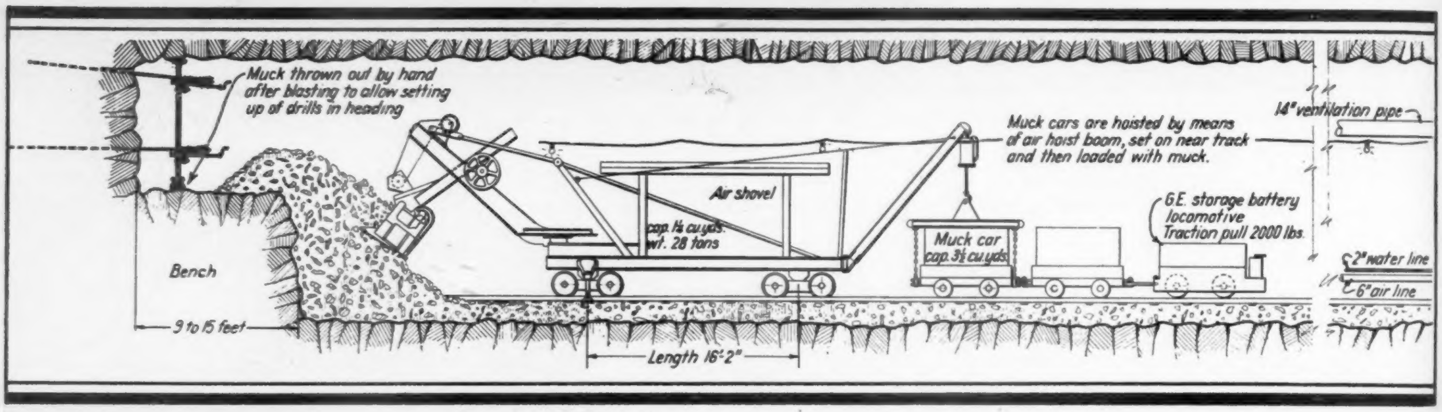
Nineteen circular shafts, from one mile to two miles apart, were sunk to tunnel line, and 29 headings were opened from these shaft bottoms. A mantle of soil having a depth of as much as 150 feet covered the rock at some points along the tunnel line. This surface material was water-bearing in some cases; and, as a result, nine of the shafts were carried to rock as pneumatic caissons. Eight were started as open cofferdams, and the remaining two were in rock from the surface. All shafts were lined with concrete and will comprise parts of the permanent structure, as water will be conducted through them to the pipe distribution system just beneath the ground surface.

All shafts were equipped with electrically operated balanced cages of approved mining type for lowering men and equipment and for raising spoils to the surface. Cars of excavated material are run out on elevated platforms and dumped by gravity into trucks below. It is estimated that 235,000 truck loads of rock and earth, each containing 7 cubic yards of material, will be handled during the course of the work. Because of the



Above—Three-piece supports used to carry the roof in bad ground.

Left—A grouting crew at work, showing the pump on a car and, at its left, the air hoist used for pulling the assembly ahead.




Diagrammatic representation of the method of excavating.

lack of disposal space in the city it is being hauled to barges and towed out to sea for dumping.

It will be apparent to the reader that it constitutes somewhat of a problem to carry on the surface aspects of such a mammoth mining operation without unduly disturbing established urban activities. To this end shaft sites were chosen with care; and in certain neighborhoods, where 24-hour hoisting and truck traffic would interfere with the comfort of residents, the shafts are not being used for elevating excavated materials. In some cases, where only small areas were available for surface plants, space was conserved by constructing compressor houses and other essential buildings as 2-story structures.

The top-heading method of driving was adopted in the tunnel, with a heading 11 feet high and a bench from 9 to 15 feet long. All drill holes are horizontal; and the average firing round consists of 50 holes in the heading and 15 in the bench. All bench holes and the cut holes in the heading are fired simultaneously and prior to the shooting of the remaining holes in the heading. Drilling is done with drifter-type drills mounted on cross bars off of columns. Between 800 and 1,000 cartridges of 60 per cent gelatin dynamite are used for each complete round and are detonated electrically. A complete round of drilling, blasting, and mucking ordinarily requires two 8-hour shifts. Most of the tunnel is in gneiss and schist, with some local areas of limestone.

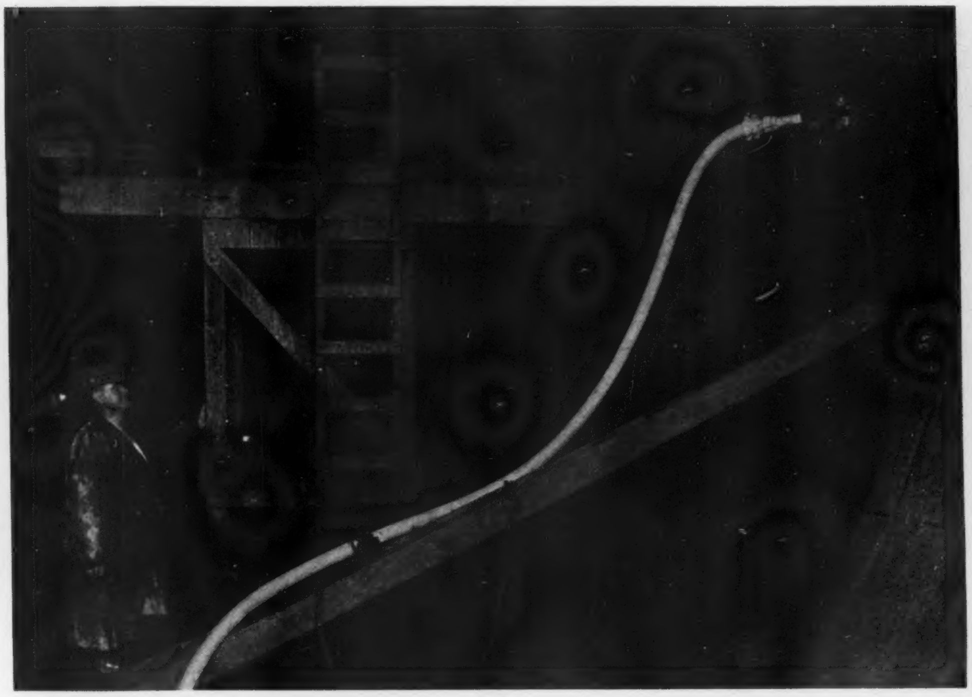
Air-operated shovels are used for mucking the broken material into 4-cubic-yard cars which are conveyed to the shaft bottoms by storage-battery locomotives. Cleaning up of the bottom is done with drag scrapers just prior to concreting. Unsound or soft rock has been encountered at various points, necessitating supporting the roof with steel. Where unusually bad ground is met, the concrete lining is placed immediately after excavating to render the tunnel safe.

The tunnel is ventilated by means of low-pressure centrifugal blowers stationed on the surface. These force fresh air through 14-inch pipes to the most effective points underground. Prior to blasting, and for an hour afterwards, each blower is reversed, thereby drawing smoke and gases from blast areas and exhausting them above ground. Mucking usually starts within 1½ hours after blasting.

The tunnel is being lined with 17 inches of concrete. The material is delivered to the shaft heads in truck mixers and sent underground to points of placement. The invert and side walls are poured from dump cars. The arch, constituting the upper half of the tunnel section, is placed pneumatically. Concreting has followed excavating fairly closely, and a considerable portion of the lining is now in place.

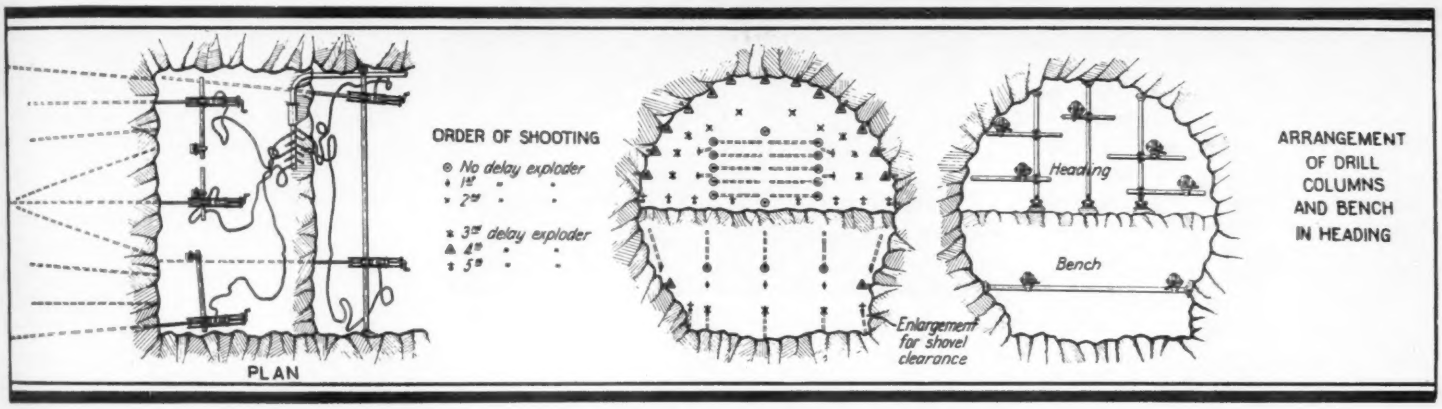
When this concrete lining is placed, 1½-inch grout pipes are inserted at various points in the upper side walls and arch. The distance between pipes is not a fixed one, and depends upon the character of the rock and the manner in which it broke during the rough excavation work. The rule followed is to place a sufficient number of pipes to insure complete filling of all the voids and spaces between the rough rock walls and the concrete lining as well as penetration of the cracks which may have been opened up in the rock surrounding the bore.

Engineering experience has shown that in a tunnel of this kind the grout should be forced



Above—Steel interlining installed to control strong inflow of water.

Right—A grout line connected to a pipe in the tunnel lining. The first injection is made at a pressure of 400 pounds.




The scheme of drilling and blasting in typical sections.

into place under a pressure equal in pounds per square inch to the number of feet below the surface at which the work is carried on. Specifications read accordingly. In this case it meant that the average ultimate grouting pressure would have to be around 600 pounds per square inch. When in operation, the tunnel will be required to withstand a water pressure of 350 pounds to the square inch.

Prior to the beginning of grouting operations, experiments were carried on with equipment which the McGovern Company had used on previously constructed tunnels at lesser depths and at consequently lower pressures to ascertain if it would be suitable for the work in hand. This formerly used method consisted of boosting 100-pound air from the regular compressor plant by means of two or more small compressors connected in series. The high-pressure air thus obtained was used to place the grout, a small quantity at a time, by displacement.

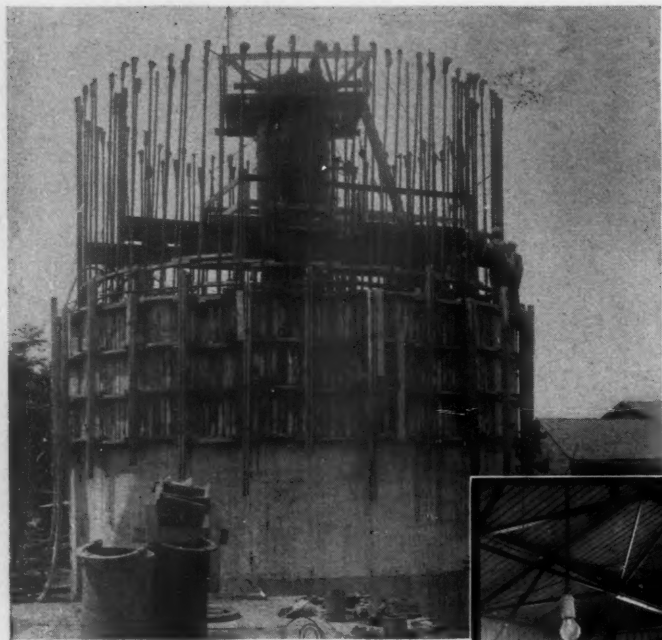
It soon became apparent that this system would not suffice. In the first place, it was difficult to secure requisite pressures and to maintain them once the valve was opened and the air was allowed to expand in the piping system. Secondly, it was possible to place only about six bags of cement an hour, which was prohibitively slow in light of the fact that there would be required an average of three bags of cement per linear foot of tunnel, or a total of more than 300,000 bags. There was also an added element of danger in having so many pipes and hose connections under high pressure.

In an effort to develop an improved method, they tried one of the Cameron Type LSS pumps used for keeping water from headings during tunnel driving. Encouraging results were obtained on the whole; but it was found that the valves would not give long service. From time to time they became blocked up with grout and had to be discarded.

It was then decided to try a Cameron Type VPS pump—a vertical, plunger-type pump of which more than twenty had been used for dewatering shafts during sinking. In an effort to overcome valve troubles, Ingersoll-Rand Company, manufacturers of the pumps, were asked to make a special valve chest. This was done—the new chest providing for horizontally disposed valves when the pump is in a horizontal position, whereas the standard arrangement calls for horizontal valves when the pump is in a vertical position.

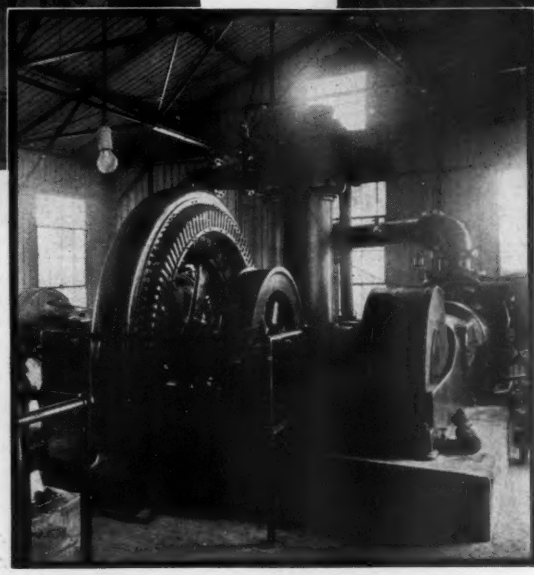
Upon trial, the VPS pump with the special valve chest was immediately successful, and arrangements were made to equip others in like manner. The size which is being most used is the 9A, which has a cylinder diameter of 12 inches, a plunger diameter of 5 inches, and a piston stroke of 13 inches.

Some of the accompanying photographs show the set-up of the equipment for the grouting operation. The pump, in horizontal position, is mounted on the forward unit of three trucks fitted with railroad-type wheels. In front and at one side of the pump is mounted an Ingersoll-Rand Type 10H hoist for pulling the trucks ahead. The rear truck contains a standard grout mixer which discharges through a screen into a suction basin for the pump. This basin occupies the intermediate truck. The grout is prepared by mixing from 7 to 9 gallons of water with each bag of cement. Both mixer and pump are operated by compressed air, at 100 pounds pressure, which is piped into the tunnel from the stationary compressor plants on the surface. Cement is brought up to the trucks in 100-bag lots on



Caissons, used in shaft sinking, were built up in sections as the huge concrete cylinder settled into the ground.

A vast underground chamber at one of the shaft bottoms more than 500 feet below the city streets.



A 2,300-cubic-foot Class PRE compressor installed adjacent to one of the shaft heads.

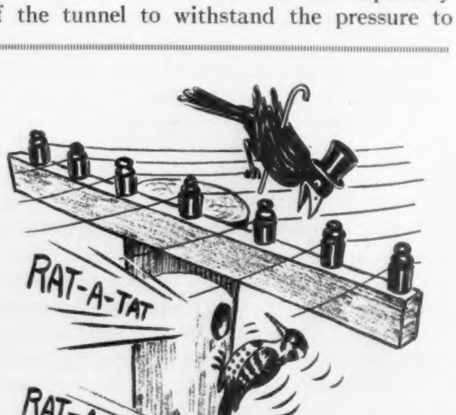
a car hauled by a storage-battery locomotive. A spare pump and grout mixer are kept above ground at a shaft near the grouting operations for immediate lowering and use in case they are needed. It has been found that with the special valve chest, a rubber valve will stand up, on an average, until around 4,000 bags of cement have been handled. It can then be turned over and will give another like period of service.

The grouting is being done in two stages. In the initial stage, a pressure of at least 400 pounds is used. A connection is made with a grout pipe, and the valves on the pipes for a considerable distance ahead are opened. Pumping is continued until grout runs out of one or more of the forward pipes, at which time the outfit is moved up and a new connection made at one of the points of discharge. Ample evidence that the grout is circulated under great pressure and that it is reaching remote voids and cracks in the rock is furnished by the fact that it sometimes emerges from a pipe as much as 400 feet ahead of the pumping point.

After the entire tunnel has been gone over once in this way, it will be covered again. In this second stage of the work, connection will be made with all those pipes through which no grout was pumped during the first stage of the operations. The pressure will then be increased to 600 pounds. Figures covering some of the first-stage grouting disclose a remarkable increase in speed of placement over the 6-bag-per-hour method that was at first considered.

The success of the grouting system has contributed greatly to the rapid progress that the contractor is making in finishing up the tunnel. It also insures a thorough job that will remove all doubt as to the capability of the tunnel to withstand the pressure to which it will be subjected when in service, as nothing but pure grout is forced into the voids and seams instead of a mixture of grout and air.

The tunnel is being driven under the direction of Thaddeus Merriman, chief engineer of the Board of Water Supply of New York. The field work is in charge of C. M. Clark, department engineer, assisted by R. W. Armstrong, senior division engineer. Patrick McGovern is in direct charge for his company. John S. MacDonald, vice-president and chief engineer, C. H. Harrington, and Patrick Porter are supervising the work along different sections of the route.




Boss Woodpecker: "I'll have to put on more drillers to finish these apartments by October."

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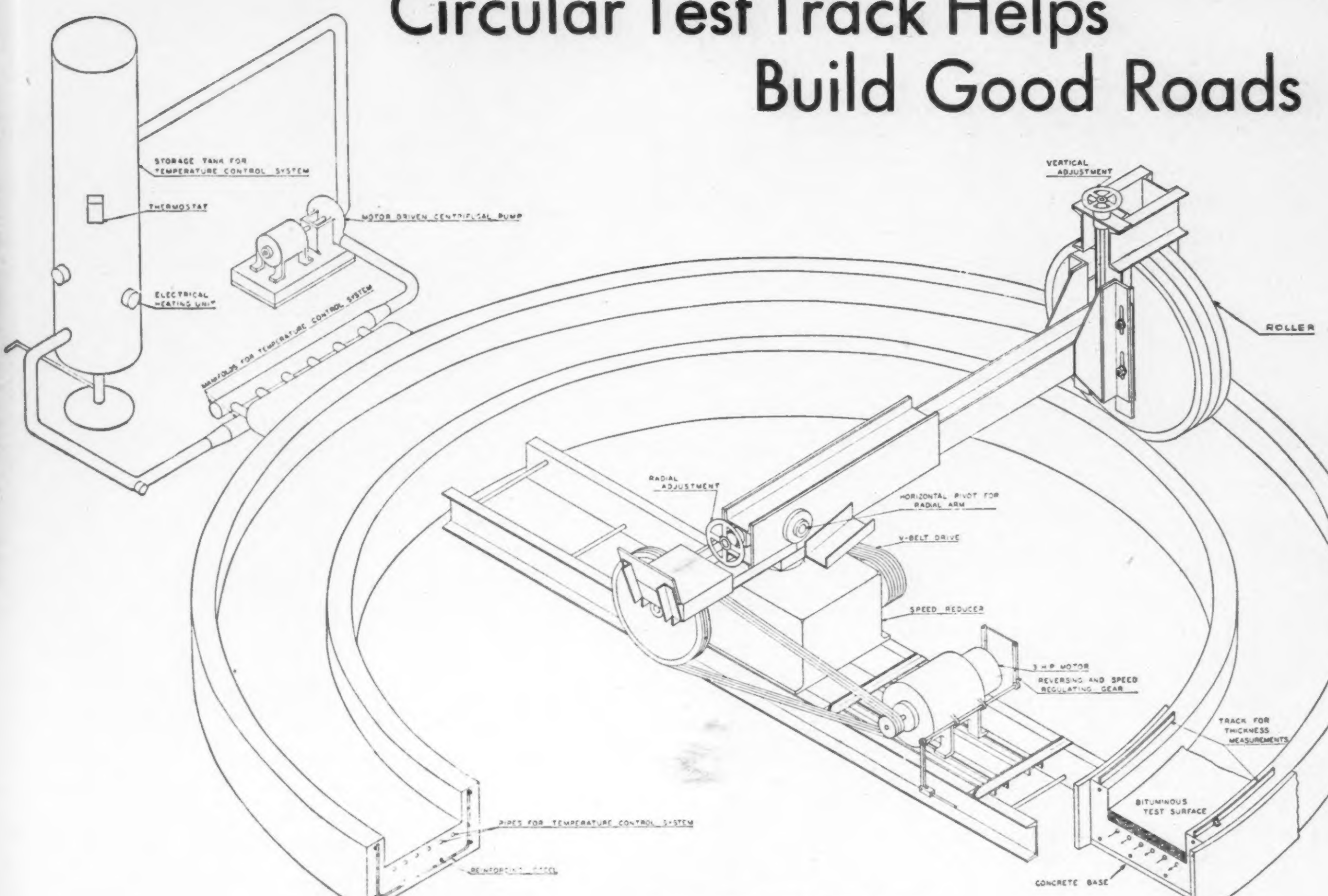
On the strength of the numerous requests for information on lubricants and their application, the lubrication engineering committee of the petroleum division of the American Society of Mechanical Engineers is preparing what is announced by it as a complete course of instruction for the training of lubricating engineers.

The course is being planned by leading experts in the petroleum and allied industries, and will deal with the fundamentals of lubrication and with the application of lubricants to all classes of machinery. It will teach the student how to test machinery in order to determine if a certain lubricant is the best for the most efficient working of a particular machine; and it will also show him how modifications in the systems of application can be made so as to reduce wastage to a minimum. The training course will be distributed by the society after it has been approved and accepted by the various trade associations involved.

# Circular Test Track Helps Build Good Roads




Courtesy, The Crushed Stone Journal

PRONOUNCED changes in automotive vehicles are apt to mean changes in highway construction, and there have been many of these since the inception of the automobile. To keep pace with the demands of traffic and to solve the diversified problems that arise, the highway engineer has much research work to do both in the laboratory and in the field. Experimental roads, interposed in the regular lanes of traffic over which trucks and motor cars roll along in the regular course of their business, have been of much assistance to him in determining the service behavior of different types of construction. But this method of getting information is slow, and may involve considerable expense.

A circular test track has been added recently to the equipment in the laboratory of the National Crushed Stone Association by means of which it will be possible to tell in advance of building how finished roads will stand up under traffic. It was designed principally to promote the interests of the crushed-stone industry—crushed stone being an important ingredient in secondary highways that are now said to be engaging the attention of the highway engineer more than ever before.

The track is 14 feet in diameter and has a runway, 18 inches wide, upon which test surfaces can be built up to a maximum thickness of 6 inches. The runway rests on a reinforced-concrete base 6 inches thick and 2 feet 2 inches wide including curbs. In this base a system of hot-water pipes is laid in such a manner that the entire runway can be kept at a constant temperature. This is important in experimenting with bituminous materials. The water is heated by several electric heating units and is circulated by an electrically driven centrifugal pump. By means of this system, any desired temperature up to 140° F. can be maintained; and winter conditions can be simulated by simply substituting a refrigerating plant for the heating plant. By flooding the track it is possible to study the effects of continuous moisture on various test surfaces.

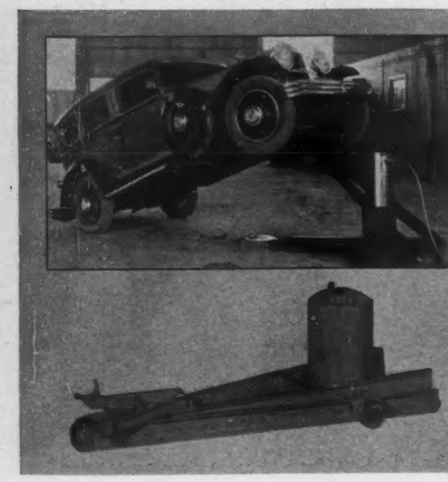
The load-applying mechanism consists of a wheel, carried at the end of a radial arm, and was designed with a thought to the action of traffic on highways. It is driven by a 3-hp., reversible, variable-speed motor through a vertical, rotating axle located at the center of the track. Mounted also at the center of the track is a vertical speed reducer having a ratio of 50 to 1; and V-belt drive through a countershaft permits of further speed reductions. Still further variations in speed may be obtained by using pulleys of different sizes with the V-belt driving mechanism. All this makes for great flexibility in the speed with which the wheel can travel over the runway.

By means of a roller, 3 feet in diameter and 6 inches wide, the test sections can be rolled in the same manner as are regular roads built of crushed stone—the arrangement of mounting being such that the entire width of track can be gone over. The roller is composed of three segments which operate independently. This was done to prevent any dragging over the surface that might otherwise occur because of the difference in the length of travel between the inner and the outer edges of the roller.

When the test surface is ready, the wheel takes the place of the roller at the end of the radial arm. It is of the motor-truck type, and is equipped with a pneumatic tire that has an over-all diameter of 34 inches and is charged with air at 55 pounds pressure. Before it is started on its run around the track, the wheel is loaded up to its maximum capacity of 1,900 pounds by weights of concrete in which iron slugs are the coarse aggregate. These weights, as well as the wheel and the roller, are handled by a hoist.

At the present time the testing machine is operated at a speed of three miles per hour. This, however, may be increased to twelve miles with safety—the centrifugal forces that may come into play at higher speeds having been taken into account in designing the track. So far it has been utilized to investigate the stability of various gradations of crushed stone and other aggregates and to test different kinds of cover materials used in surface treatment. Although it has been in service but a few months, the circular test track has already been of aid to the highway engineer by providing him with valuable information—information that it would have taken him a much longer time to obtain in any other way and, it is said, with less accuracy.

## SOMETHING NEW IN LIFTS FOR AUTOMOBILES



**Easily portable automobile lifts. The upper one is operated by the use of compressed air and water: the lower one by air only.**

TWO San Francisco, Calif., inventors have latterly developed portable automobile lifts that are operated in part by compressed air. One of these can raise or lower either end of a car in a few seconds by applying compressed air from an ordinary air hose. The device is perfectly balanced on roller bearings and can be moved about readily with one hand. It will elevate the front or rear end of an automobile to a height of 5 feet.

The other lift makes use of both compressed air and water. When raising a car it is hydropneumatic in its operation: when lowering a car it is entirely hydraulic in its action The device is equipped with an automatic control valve that positively locks the lift in any position; and it is mounted on swivel, roller-bearing casters to facilitate shifting. It is 6 feet long and 2 feet wide, and can elevate a load of 3,500 pounds from 6 inches above the floor to a height of 4½ feet in ten seconds.

## FUMIGATING WITH AN AIR PUMP

QUARANTINE regulations provide that all plants entering the United States shall be fumigated to prevent the spread of disease and the introduction of insect pests. Down on the Mexican border, the Federal officers in this service have been provided with a hand-operated air pump of simple construction that makes it possible for them to deal quickly and effectually with such shipments consigned to different parts of the country.

**Portable air pump used on the Mexican border in maintaining plant quarantine.**

As the laden box cars arrive, they are sidetracked and charged with deadly hydrocyanic acid by men wearing gas masks. This is a necessary precaution even though they are not required to do more than insert the nozzle of the air pump through a crack made by slightly opening the car door. The equipment, complete, weighs but 35 pounds, and is easily handled by one man.

## NICKEL-IN-THE-SLOT CLOTHES BRUSH

A NEWCOMER in slot machines for the public convenience is the Val-a-Vac, an electrically operated vacuum cleaner that, upon the insertion of a nickel, enables a man to brush his hat and clothes. The dropping of the coin releases a length of wire-reinforced hose, at the end of which are two bristle brushes set in a swivel handle. The service is limited to 2½ minutes. During that interval the hose is gradually and automatically reeled back into its case and locked by means of a motor-driven timing device. For the use of private establishments, such as clubs, the Val-a-Vac can be made to operate free of charge. The machine is said to meet with the approval of health authorities because it works on thoroughly hygienic lines.

**Making himself look presentable by the aid of the Val-a-Vac.**

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There has recently been approved by the American Standards Association, working in coöperation with the American Mining Congress, a safety code covering all phases of coal-mine transportation. The code is the outcome of long investigation, and embraces transportation on level and inclined tracks both underground and in mine yards; haulage by motors, animals, or men; and a complete system of signals and safety rules. Copies may be obtained by addressing the American Standards Association, 29 West 39th Street, New York City.

## INDUSTRIAL LITERATURE

THE DIRECT Separator Company, Inc., Syracuse, N. Y., has issued a leaflet describing a new "Divide" combination air separator and trap for removing water and oil from compressed air. The device depends upon the difference in the weights of air and liquid to effect a separation. While the flow of the air is being twice reversed, the oil and water are deposited upon the sides of a cone, from which they drain into a trap below. Further separation results when the air is finally directed against a perforated trapping sheet and its flow again reversed before it leaves the enclosure. This sheet likewise serves to prevent any liquid from being carried out of the water chamber. The new separator is made in sizes having pipe connections ranging from ½ inch to 2 inches in diameter. Each unit is carefully tested before being shipped.

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*The Flow of Air Through Circular Orifices in Thin Plates* has been published as Bulletin 240 by the University of Illinois. It is a report upon an investigation to verify and extend the range of existing data on the flow of air through square-edged circular orifices in thin plates. The bulletin was written by two members of the faculty, Joseph A. Polson, professor of steam engineering, and Joseph G. Lowther, research assistant in mechanical engineering.

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*Nickel Steel Topics* is a new 12-page, illustrated publication to be issued bi-monthly by The International Nickel Company, Inc., 67 Wall Street, New York. Its purpose is to disseminate technical, semi-technical, and news material dealing with the production, treatment, and use of nickel alloy steels in rolled, forged, and cast forms. It includes a question-and-answer section and other special features.

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Ingersoll-Rand Company, 11 Broadway, New York, has issued a 20-page illustrated catalogue covering portable air compressors, "Jackhamers", and other tools and equipment designed for use by contractors, public utilities, roadbuilders, and quarries.

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A 20-page, illustrated circular describing mechanical oil burners has been issued by Schutte & Koerting Company, Twelfth and Thompson Streets, Philadelphia, Pa. These burners are designed for use on standard boilers and on industrial furnaces of various kinds.

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The Leavitt Machine Company, Orange, Mass., has issued a 16-page, illustrated catalogue describing the Swendeman automatic separator for the removal of water and oil from compressed-air lines.

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*Positive Dust Collection at Low Cost* is the title of Catalogue No. 1391, issued by Blaw-Knox Company, Pittsburgh, Pa. This 16-page, illustrated booklet describes the Blaw-Knox framed cloth-bag dust collector.

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